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By a divided bench, the United States Supreme Court has overthrown the Employers' Liability Act of June 11, 1906. Four justices—Harlan, McKenna, Holmes and Moody—held that the law was valid in whole or in part; a fifth—Justice White—believes that it can be so redrawn as to be valid. Chief Justice Fuller and Justices Peckham and Brewer believe that Congress has attempted regulation repugnant to the Constitution. Thus the application of the law is stopped, the majority opinion being that it was so drawn that the unconstitutional parts were inseparable from the constitutional; but application of the underlying principle is, apparently, only postponed. Two interesting comments suggest themselves—first, that many of the extremely important, radical corporation cases now pending before that august body are pretty likely to terminate in the same way; second, that there are two distinct parties in the court, one of which is willing to see Congress do a great deal more regulating than the other is, and that between these parties the balance of power is quite uncertain, depending on the vote of several justices to whom each case is a new case.

We begin this week the publication in serial form of a paper by Dr. Smith, of the University of Pennsylvania, on the Ocean Carrier. Many historians have described the upbuilding of the merchant marine in this country and foreign countries, and excellent literature on marine architecture has always been available, but Dr. Smith, so far as we know, is the only writer who has studied the development of the ocean carrier from the direct standpoint of the world commerce that the carrier exists to move. In his previous monograph on the Organization of Ocean Commerce, he discussed charter traffic and line traffic and the reasons why line vessels and charter, or tramp, vessels afford respectively the natural and efficient methods of serving different kinds of traffic. Where the freight is, where it is going, how it can best be gotten there, and how much it costs to do it—these are the kinds of topics that Dr. Smith treats of, showing, by the way, how certain types of carriers have been developed while other types have been discarded, and discussing the competitive conditions that have had so strong an effect on modern ocean business. Most traffic men come into contact with a greater or less number of these problems, at one time or another; the history and discussion of them ought to interest them all, and the bearing of water transportation upon rail transportation is so great and is constantly becoming so much greater, owing to the world-wide competition of commodities in search of a market, that the fundamental principles involved ought to be known a great deal more widely than they are. In England, where the oversea dairy products of Denmark compete actively with those of Devonshire, and nearly every important rail route has a competing water route, the nearby conditions are well appreciated. We have continuous water competition on the Atlantic, Pacific and Gulf coasts and an open-season competition along the Great Lakes and in many other localities, the conditions of which are fully understood, but we also figure in a series of world traffic routes that are not understood so well, and that are yearly becoming more important, as commerce expands and the marine engine becomes more efficient. The purpose of the present series of articles is to put some of these matters on record in a form as definite as that of the mere physical history of the steamships in the Atlantic trade.

THE 1908 RAIL ORDERS SITUATION.

The present rail situation is without precedent, and this is meant to include the acceptance of the new specifications, which seems to be quite general; the differing methods now being undertaken to the end of securing safer rails and more economical rails; the prices for better quality; and, lastly, the fact that but few large orders for 1908 delivery have thus far been placed with the mills. We are told by the officers of the steel companies that their December correspondence with the railroads with reference to new orders has been extraordinarily large but, owing to the unsettled conditions above referred to, the holding back of orders was what might have been reasonably expected.

Probably every railroad officer in the United States has been stirred by the development of the extent to which rails break. He has also been moved by the knowledge that rails are so soft as to make a large percentage of increase in the cost of rail maintenance. Undoubtedly also the financial situation is in many cases causing delay in giving orders; first, because it is harder to provide the money to pay the bill, and, second, because in many cases thorough investigations have been made and are still being made to see to what extent the quantities ordered for 1908 can safely be reduced below the average amount required for maintenance. For example, the average amount needed for maintenance on the Pennsylvania Lines West may be said to be about 60,000 tons a year, and for the

Pennsylvania lines east of Pittsburg more than 100,000 tons. The New York Central Lines east of Buffalo need something like an average of 50,000 tons a year. But never before in the history of these two roads has the track been of such a high standard as it is now. It is highly probable that no danger would be involved and no considerable loss caused by reducing the amount of new rails used this year to one-half or possibly one-third of the average amount. This statement is generally true of the railroads throughout the country so that nearly all of them, under financial stress, can make a quick temporary economy by reducing rail orders, and this fact is a considerable factor in the present situation.

The most important item in the new specifications left undecided was the percentage of discard from the top of the ingot to be agreed on by all railroads and to be in force at all mills. We are told that when prices have been asked for rails with a specified discard, those prices have been figured on the basis of $28 a ton for rails made from ingots with a 9 per cent. discard, with an additional cost of 5 per cent. for each additional 5 per cent. of discard. This would make $30.80 a ton for 19 per cent. discard and $32.20 for 24 per cent. discard. This cost would not seem to be unreasonable if the rails were made hard enough so as to effect economy in use in addition to the presumed avoidance of the cost of broken rails. In the matter of price the effect of concentration of ownership of mills has thus far been good. Judge Gary has expressed the sum of opinion, after consultation with many railroad presidents and with his own officers, that $28 a ton is, for all concerned, a good price to adhere to. The mills gave us all a good lesson when they maintained the $28 price for rails during a period when billets were selling for $32.

The failure to agree upon a fixed discard from the ingot by the committee last October was a disappointment to many others as well as to us. Nevertheless, disappointment should never mean discouragement. There is an old song with a line: "The best cure for misfortune is to marry again." The study and the work on this subject has not halted. It has not been confined to the members of the American Railway Association rail committee. Experiments have been made at three different mills to learn if physical defects can always be detected by breaking up crop ends from rails made from that part of the ingot where such defects commonly occur. If this proves practicable, and if the whole heat is rejected when a physical defect is so found, it may be a more scientific method than saying arbitrarily that in every case either a quarter or a fifth of the ingot must not be used. Involved also in this undertaking is a legible numbering of each rail, locating its position in the ingot, so that the record of breakages may indicate something more than it now does; and also so that users may, if they choose, select for the severer services rails with the higher numbers—made from the lower end of the ingot.

There is now intelligent co-operation between the manufacturers and the railroad officers to the end of finding whether the arbitrary discard, which may be presumed to be effective, but which is certainly wasteful, is the only way out. The object of the present study and experiments is, if possible, to devise a specification which will avoid that waste, secure sound rails and furnish to the mills the greatest possible incentive to the improvement of the ingot.

THE VALUE OF TIE PRESERVATION.

The timber preserving plant which the Burlington has built at Galesburg, Ill., described in another column, is the seventeenth treating plant to be built by a railroad in this country, if the record before us is correct. This includes three portable plants of the Union Pacific, Oregon Short Line and the Southern Pacific respectively, and a plant of the Denver & Rio Grande which, though nearly completed for some time, has not yet been put in operation. But, on the other hand, it does not include the large number of privately-owned plants, a part or all of whose product is taken by the railroads on which they are situated, nor two plants of Mexican roads. The estimated capacity of the 17 railroad plants is around 16,500,000 ties a year. The Government report on the consumption of ties for 1906 recently issued (*Railroad Gazette*, Dec. 20) gives the number of ties treated by the roads at their own plants in that year as 6,365,523, and the number of treated ties bought as 4,773,116, or a total of about 11,000,000 treated ties used by the steam roads. On the basis of the estimate given above the number of ties treated by the roads in 1906 was about 40 per cent. of their present estimated plant capacity. All of these plants, with two exceptions, are west of the Mississippi river. This is due to the greater scarcity in this region of suitable tie timber and the need therefore of using the inferior soft woods. But some of the eastern roads have been giving serious consideration to the matter for a year or two past and one of them had practically decided to build one or more plants when the unfavorable monetary conditions caused a postponement; another is proceeding with preparatory work, and others have been making investigations that doubtless will bear fruit in the near future.

A report to one such road on methods and costs of treatment and the saving to be realized, which would be the justification for the installation of a preserving plant, figures conservatively as follows: Untreated white oak ties cost this road 85c. A treated red oak tie would cost the same, at 15c. for treating. Cost of putting in track is 15c., making the total cost of either in track $1. The life of the untreated tie is taken at eight years, and of the treated tie at 12 years. Interest is taken at 4 per cent. Neglecting interest, the yearly saving for each treated tie would be $0.0417, which can be considered the dividend paid to the plant by each treated tie during its life.

On the basis of the annual charge, at 4 per cent. interest, to be made for each kind the figures would be:

Untreated.		*Treated.*	
Interest	.04	Interest	.04
Sinking fund $\left[\frac{.04}{(1+.04)^8-1}\right]$	.1085	Sinking fund $\left[\frac{.04}{(1+.04)^{12}-1}\right]$	.0667
Total	.1485	Total	.1067

The difference, or saving, is $0.0418, nearly the same as given above.

The annual charge for the untreated tie, $0.1485, is the interest at 4 per cent. on $3.71; or, in other words, if the expenditure be capitalized, this is the sum which, at the given rate of interest, would furnish a new tie in track at the expiration of the eight-year period. How much can be paid for a tie having this same capital, which would last 12 years?

$$x + \frac{x}{(1+.04)^{12}-1} = \$3.71$$

$$x = \$1.39$$

Therefore a treated tie lasting 12 years would be worth 39 cents more than the untreated eight-year tie. If the treated tie would last 15 years it would be worth $1.65. Therefore, a treating plant having a yearly capacity of 1,000,000 ties would create a value of $390,000 if producing 12-year ties, due to the longer life. Since a well equipped two-retort treating plant with wooden buildings is estimated to cost $60,000 to $70,000, depending on the process, though not including cost of land and tracks, the expenditure for such a plant would appear to be a highly profitable investment according to the computation given.

THE RAILROAD SITUATION IN THE SOUTH.

The appointment of receivers for the Seaboard Air Line with its nearly 3,000 miles of road calls sharp attention again to the situation of the railroads in the South. A brief review of the events leading up to the present crisis in that territory will make the present situation easily understood. The recently issued annual report of the Seaboard Air Line is reviewed in another column.

From the time of the war until a few years ago, the southern railroads had a hard time to get along. There were certain short lines between important points, particularly in Virginia, North Carolina and Georgia, which were very profitable and correspondingly strong financially. But the bulk of the lines either were not specially profitable or were run at a loss. Many railroads were most of the time in receivers' hands. The process of consolidation which has resulted in putting most of the important railroad mileage in the South in the control of three dominating groups—the Atlantic Coast Line-Louisville & Nashville, the Southern Railway and the Seaboard Air Line—began by the extension of the ownership and influence of some of the smaller and very profitable roads. A connecting line would first be taken over, then a line connecting with that and so on until the present systems were formed, stretching from Virginia and Kentucky on the north, to the gulf states. In this process a good many lines locally unprofitable, but necessary as part of a through connection or as a protection against competition, were acquired or built, so that the large systems were usually made up of strong roads, roads which were little more than solvent, and weak or bankrupt roads. For instance, in the case of the Seaboard Air Line, the Seaboard & Roanoke Railroad running from Portsmouth, Va., to Weldon, N. C., the original

nucleus of the system, was one of the richest roads in the South.

It was inevitable that systems made up of such different kinds of railroads, many of them running through a territory which had for years produced little traffic, should be found wanting when there was suddenly developed a tremendous increase in industrial activity. These roads had not been built to be low-grade through lines and they had not had funds even if they had had faith to undertake, previous to the need for them, large improvements which would amount in many cases to reconstruction. As a result, when the rush of traffic of the past three years came, the railroads of the South were unable to satisfactorily carry it. It was large enough to require much new double track, many grade reductions and a large amount of new equipment, and these, particularly the first two, cannot be provided in a day. Not only were the weak lines of light traffic overtaxed, but all these pouring their freight together at the various throats of the different systems made still greater congestion on these connecting routes which had previously been the most efficient parts of the roads. The new high traffic level went far beyond the increase in railroad facilities.

The resulting unsatisfactory service, both freight and passenger, gave an opportunity to that class of politician, even more abundant in the South than elsewhere, who appeals for success to public prejudice and passion. Anti-railroad political campaigns were waged in most of the southern states and were generally successful. One great reason why the railroads were unable to make effective opposition to these attacks was that their influence had in the past been strong in the state legislatures and that they therefore could not come forward with clean hands to oppose the unjust proposals of the demagogues. Another was that the South had suffered some of the most flagrant cases of railroad financial jugglery ever carried out in this country, and these more recently than the similar instances in other sections, so that the sincerity of railroad managers was under suspicion. Not only were anti-railroad governors elected, but legislatures also, and the laws passed during last winter's sessions were peculiarly severe.

The rest of the story is only too familiar—decreased net earnings, the impossibility of selling securities to pay for new improvements which were under way and the consequent stopping of these improvements, the conflicts of jurisdiction between State and Federal courts, the extra session of last fall in Alabama called for the sole purpose of bringing the railroads to terms, and finally an industrial reaction in the South, followed by decreases in gross and net earnings and the receivership of the Seaboard Air Line.

Already, however, there have been certain encouraging changes. Public sentiment toward the railroads is showing a decided change. The business men of Alabama as well as the organizations of railroad employees have sent delegations to the Governor protesting against the attacks on the railroads. All kinds of business have already felt, and felt severely, the effects of the reaction, and the farmer, whose railroad ties are no longer as good as currency at his local store, feels the change also. In the case of at least one of the important systems in the South the tactics of the railroad officers have also undergone a change. There is to be no more hurrying to Raleigh or to Columbia or to Montgomery to try to head off hostile legislation. The president, the vice-presidents and the general manager intend in future to devote their time to the business of railroad operation. If the people of the various states through which the road runs insist on ruining it—as there is no doubt they can do—they are to be allowed to bear the whole responsibility for so doing. Most important, of all, as this last statement implies, this railroad is no longer in politics.

This is a strong and sensible stand for the railroads to take. Had it been taken in the past, it is probable that much harm could have been avoided. Whether this is true or not, it is certain that the system of political influence failed utterly to protect the railroads in their hour of greatest need. There is no doubt that the present situation in the South, with is rapidly decreasing traffic, its locomotives newly received from the builders but lying in the shops without the packings taken off, its idle freight cars and its decrease in earnings is a discouraging one; but there is already a promise of a fairer and more honorable relation between railroads and people which should result both in shortening the depression and in uniting both elements, lately so hostile, in the task of developing the South. Specifically, the bare fact that one of the great systems is now so situated that the tactics of state legislators will be met in the open by federal receivers instead of by corporation officers, is of great interest and importance, not only to the Seaboard itself, but to all other southern railroads.

GOOD AND BAD WORK UNDER THE RATE LAW.

The report of the Interstate Commerce Commission is an interesting document and in many ways a conservative one. Yet the point of view which runs through it from beginning to end and appears in one form or another in every recommendation which the Commission makes, is wrong-headed. The Commission assumes, as if there could be no debate on this point, that all citizens desire to see governmental regulation of the railroads made as tight and as complete as possible. Thus—"one is forced to conclude that an authoritative valuation of railway property is the next important step in the development of governmental supervision over railway administration." From the sentence quoted, one is also forced to conclude that the idea of the Commission is to increase and expand governmental control stone by stone and brick by brick until some sort of structure is arrived at, the dimensions of which are not clear in the commissioners' own minds as yet.

This point of view illustrates a very serious deficiency and a potential source of much harm in the scope of the Commission's work. We maintain that proper regulation of public service companies is good, provided that this regulation consists of such police powers as may be necessary to protect the lives of travelers and the property of shippers, and the freedom of every man to do business on equal terms with his neighbor. These things can be accomplished under very simple legislation, and, in the main, were fully provided for before the Rate Law of 1906 was enacted, although in some respects justice was facilitated by this law, and the small shipper was given a practical instead of a theoretic basis of equality with his more powerful neighbor before the law. The reason that the work of the Commission has on the whole been good and helpful during 1907 under the new law, has been that this work has proceeded along elemental lines of ordinary fairness. The Commission has attempted nothing radical; it has simply heard the respective cases of the railroads and of their customers, and has found the customers wrong just as often as it has found the railroads wrong. But, as the Commissioners themselves intimate in their report, the chief reason why there has been greater harmony this year between shipper and carrier than has generally prevailed, has been the fact that a tribunal existed. It may be said, somewhat paradoxically, that the efficiency of a city police force is measured not by the arrests which are made, but by the arrests which do not have to be made, and the same thing is true of the year's work of the Interstate Commerce Commission.

In only one important instance has the Commission attempted to make a radical branching out from the precepts of simple justice, and in that instance it has done harm already and has paved the way for much subsequent trouble. We refer to the arbitrary accounting requirements. No careful student of the subject will be disposed to deny that the railroads ought to keep their accounts honestly and in such form as to be intelligible to those who are entitled to see them. But an inflexible system of required depreciation charges is a thoroughly bad thing when applied to American railroads, and the proposal that all betterment charges from income should be clearly ticketed, is not as equitable as it looks. The American railroad system is not old enough or stable enough to provide annually a fixed sum or a fixed proportion for the up-keep of its property. In time it will be, so far as the important lines are concerned. But neither this generation nor the next is likely to see a succession of years with changes in traffic so slight that income and expenditure may be measured year after year with the same rule. It is characteristic of an old country that its commercial business is stable; it is characteristic of a young country that its commercial business fluctuates widely, and so long as America is a young country and has nowhere nearly grown to fill its shoes, its railroad traffic is going to have fat years and lean ones. The custom, long established, of spending great sums on a property in years of abnormal prosperity and economizing strictly in years when prosperity is below the average, has given good results in the past, and attempts to arbitrarily change this practice are not going to do any good.

An average of expenditure can be struck which, when spread over a dozen years, is about right, but the money is not spent in equal sums. In a certain year a railroad knows that it is earning materially more than it has ever earned before and more than it can reasonably hope to continue earning, season after season, without relapses. It seems to the manager wiser to put some of this money back into the property than to declare an extra dividend—and the Commission has no quarrel with him here. What the Commission does want is to have that extra betterment disbursement separated from the regular maintenance charge so that everybody

can see it. Surely no proposition could sound more equitable than this; but, unfortunately, it omits consideration of one very important thing—human nature. When the shipper who thinks he pays too high a rate, or the tax assessor who wants to increase state revenues, sees this free sum ready to be put back into the property, he proposes to get some of it for himself first, and laws are forthwith passed reducing rates and increasing taxes to absorb this obvious operating surplus. But if business slackens, and there is threat of hard times, rates do not get put up again and taxes put down. The railroad manager has been in the business some time and knows that great prosperity does not continue forever; the legislator is interested only in the year's earnings. What this all comes to is that substantial betterment work has got to be done out of earnings, in good times, if it is done at all—and the Commission's theoretic rulings on this subject have greatly increased the difficulties of doing this work.

From these concrete illustrations of the efficiency of the Commission when it devotes its attention to its police functions and to the inefficiency of the Commission when it attempts to proceed along new and radical lines, one ought to be able to judge whether or not it should be given the new powers for which it earnestly asks. We are not disposed to criticize the suggestion that an arbitrary advance in interstate rates should be restrainable until the case can be adjudicated, provided that the Commission does not become so blocked with its duties that, as sometimes happens in a federal court, the delays in making a ruling amount to a denial of justice. But we are wholly opposed to a general valuation, so called, of all the railroads in the United States, with a view to fixing the amount and kind of securities which they can issue—to determining their rates,their payments to shareholders, and what not. We have always maintained the plain fact that a railroad valuation does not mean anything whatever, but that, once made, it will be used by demagogues and politicians just as if it did mean something. The value of a railroad is not what it costs to build it, nor what it would cost to replace it; and if we skip all this, and take a valuation based on the selling price of securities, we become at once entangled in the fact that the price of securities depends upon the earning power of the road, so that if we use our valuation to reduce rates we are going to depreciate the security, which will require us to make a new valuation, which will in turn effect a further change in the value of the security, and so on. The same objection holds true of a valuation made by capitalizing net earnings, although this valuation is the fairest kind which can be made. We do not believe that there are now any serious thinkers and economic students left who hold that the rate which a railroad charges under competitive conditions has any relation to its capitalization or to its valuation. Yet, just as surely as a governmental valuation is established, on whatever basis you please, it will be used in legislation, direct or indirect, affecting rates, which will concern not only the carrier which is subject to the order, but all other carriers feeling its competition, however remote that competition may be.

The whole thing reverts to this: that governmental regulation of common carriers is thoroughly good so far as it is confined to police work performed in a careful and conservative manner, but that it is thoroughly bad when it attempts to do the impossible thing of attending equitably to the details of finance and management which now occupy the entire attention of an enormous corps of highly trained specialists. We should much rather see the Commission work as an efficient than as an inefficient body, because we believe that it can be very useful in righting old wrongs and preventing new ones. Hence we should be extremely sorry to see it become an arbitrary, autocratic bureau charged with duties which it never could perform.

Seaboard Air Line.

"The traffic on your company's lines during the period under review shows a gratifying improvement as compared with that of the previous year. Prosperous conditions prevail in the territory through which your road operates, and with the development now in progress generally throughout the Southern States, it is believed that these conditions, favorable to your company's continued increase in business, will be maintained."

This is the comment of the Seaboard Air Line's president in the annual report for the year ended June 30, 1907, dated October 23, 1907, but not issued until the end of December. Carefully analyzed, it is no doubt literally true, but, as a description of the progress of the Seaboard Air Line during the year and of the outlook for its future, the event has proved that it is strikingly misleading. Mr. Garrett was much franker last February, some three weeks after his election as president of the Seaboard, when in an interview published in an Atlanta paper, he said that unless conditions then existing changed for the better there would be a receivership of the property.

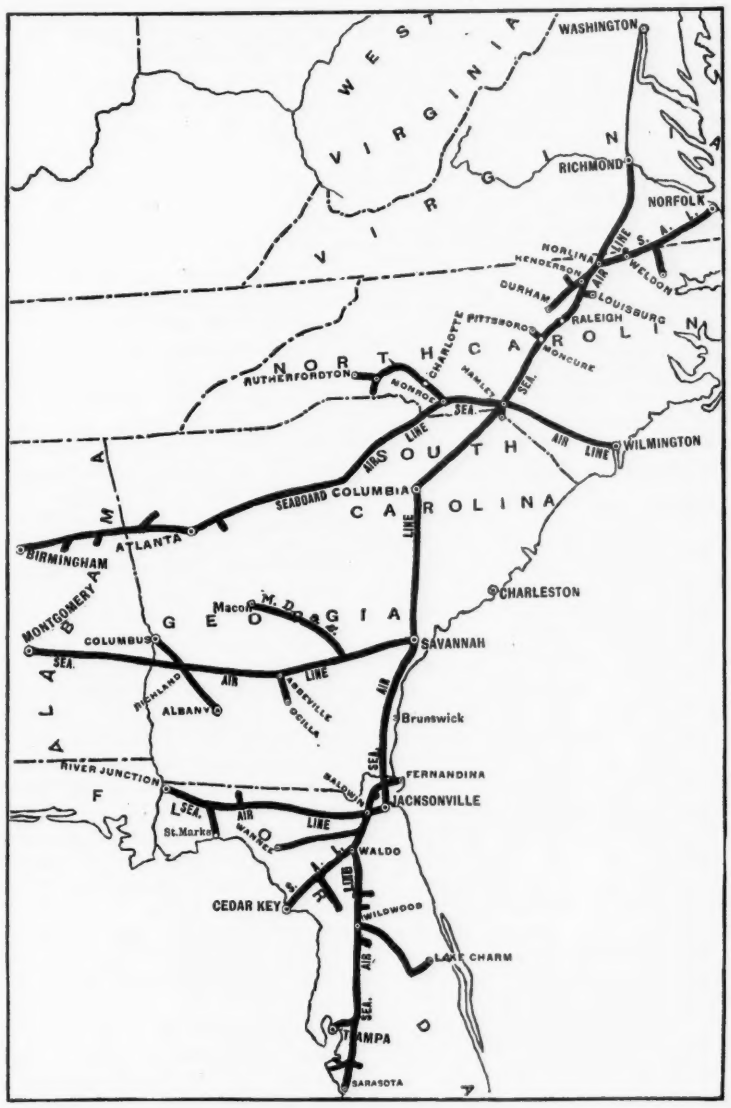
They grew worse, instead of better, and at the opening of the new year two receivers were appointed for the Seaboard Air Line, the largest railroad company in point of mileage which has suffered receivership since 1893, when a larger mileage of railroads went into receiverships than in any year before or since. The road has not had a fortunate history. Starting under the guidance of John M. Robinson as the Seaboard & Roanoke Railroad, running from Portsmouth, Va., to Weldon, N. C., 79 miles, a short and very profitable line in North Carolina, the system has been steadily expanding until it now comprises altogether 2,975 miles of line. In the effort to get through lines much mileage of thin traffic has from time to time been built or acquired. Instead of leasing the Atlanta & Charlotte Air Line, which would have brought the Seaboard from Charlotte, N. C., to Atlanta, Ga., this road was allowed to go to the Richmond Terminal company, and now is one of the best main lines of the Southern Railway. In order, however, to reach Atlanta, the Georgia, Carolina & Northern, from Monroe, N. C., east to Atlanta was built. This line when built lay between two old-established competitors for through traffic and traversed a country which then produced almost no local traffic. In consequence it was for some time decidedly unprofitable. In 1905 the Birmingham extension from Atlanta east to Birmingham was built, and this has been even more unprofitable, so much so that it has never yet been taken into the operating accounts of the Seaboard Air Line. It cost about $10,000,000, or $45,500 a mile, instead of $6,000,000, or $27,000 a mile, as had been estimated. Last year it had gross earnings of nearly $1,000,000, but its operating expenses were almost as large, the operating ratio being about 92½ per cent. As a result net earnings fell short by $512,000 of meeting fixed charges. The amount due to the parent company by the Atlanta & Birmingham Air Line increased $884,000 during the year. Yet the gross earnings of the Seaboard Air Line itself during the year on business received from this extension were only $545,000. It is evident that instead of being a help to the rest of the system, the Birmingham line has been a great drain on the finances of the parent road. Also, like all the other railroads in the South, the Seaboard has suffered during the last two years from an increase of traffic which greatly exceeded its facilities, higher wages, increased cost of materials and public hostility crystallized in legislation. These difficulties have all been made much worse by the changes and disorganization in the management, which date from January 1, 1895, when Major John C. Winder was succeeded as Vice-President by Everitte St. John.

In 1904 interests headed by Thomas F. Ryan gained control of the property, which they have since held, though under the constant bitter criticism of John Skelton Williams, formerly President and Chairman of the Board, and still largely interested in the road's securities. The Ryan party in 1905 formed the Seaboard Company to hold control of the property. Whatever else has been accomplished by it, this supernumerary holding company has failed to protect the road in time of difficulty, which was the announced reason for its creation. In 1906 Alfred Walter succeeded James M. Barr as President, and would perhaps have succeeded in bringing about the regeneration of the property as he had earlier with brilliant success of the Lehigh Valley, but before his first year of service was over his health failed rapidly, and he died on February 27, 1907. He was succeeded by William A. Garrett, who had been General Manager of the Cincinnati, New Orleans & Texas Pacific, an able and experienced railroad officer. Mr. Garrett has worked with great energy, and if it had not been for the financial crisis and resulting business depression it is possible that he would have succeeded within two or three years in putting the Seaboard property on its feet, but there were too many adverse influences, and they came too suddenly to be overcome. At a time when even the strongest railroad companies had grave difficulties in securing funds, it was impossible for the Seaboard to raise sufficient new capital, for its net earnings were decreasing, the weak points of the property had been carefully disclosed by the attacks of Mr. Williams, and the formation of the holding company and the lack of information in regard to its operations caused distrust.

Operating difficulties fell more severely on the Seaboard than on the other southern roads, because of the demoralization of its organization. The constant changes which had taken place in both the executive and operating departments, including both the highest and the lowest officers in the operating forces, had so unsettled and demoralized the organization that there was lack of co-operation, and, as the inevitable consequence, bad service to the public and expensive service to the company. The lack of confidence of the employees in the management and of the management in the men appears to have been one immediate and direct cause of the great decrease in net earnings. During the early part of 1907, when traffic was heavy, the road was very short in both power and equipment, and a great many of its locomotives were in bad condition. Shop facilities, side tracks and terminals were altogether inadequate to meet the demands of traffic. These physical handicaps taken together with the lack of efficient organization, resulted in an operating ratio, not including the Birmingham extension, which is said to have risen last March as high as 90 per cent.—a figure which leaves little or nothing with which to meet fixed charges.

The results of operation for the fiscal year ended June 30, 1907, show all this. Gross earnings increased $1,300,000, or 9 per cent., but operating expenses rose $2,400,000, or 23 per cent., the result being a decrease of $1,100,000, or 24 per cent., in net earnings. The operating ratio increased from 70 per cent. to 79 per cent.—a very sharp rise. Worst of all, the increase in operating expenses came largely in conducting transportation, which account was $1,700,000, or 27 per cent. larger than in 1906, and rose from 40.7 to 47.7 per cent. of the gross earnings. No further proof is needed of the disorganization of the operating forces than the fact that the Seaboard Air Line had to use nearly 50 per cent. of its gross earnings for paying the direct costs of getting and moving the traffic. The Southern Railway with all the great difficulties which it had to face used only 42.2 per cent. of gross earnings last year for this purpose.

At the same time that there was a decrease of $1,100,000 in net earnings there was an increase of over $300,000 in fixed charges. The two unfavorable influences together were large enough to change a net income of a little less than $1,000,000 in 1906 to a deficit of



Seaboard Air Line.

Including Atlanta & Birmingham Air Line and other subsidiary roads.

nearly $500,000 last year. These are the results from the operation of the rail lines. The water lines, made up of the Baltimore Steam Packet Company, showed a net income of $154,110 last year, so that the total deficit was reduced to a little more than $300,000, this figure however not including the deficit on the Birmingham line.

The largest proportionate increase in net earnings during the year was in passenger earnings, which were 15 per cent. larger than in 1906. The passenger density increased from 52,000 passengers one mile per mile of road to 61,400. The average distance carried rose from 45 miles to 48 miles, probably reflecting the development of the through Florida traffic, for which last winter was a profitable one. The legislative rate reductions of the various southern states began to show their effect in a slight reduction of the passenger-mile rate.

Freight earnings increased 6 per cent., and the freight density from 368,000 tons one mile per mile of road to 392,000. There was a slight reduction in the ton-mile rate. The trainload (whether including company freight or not is not indicated) rose from 194 tons to 208 tons. Gross earnings per mile of road were $6,292, against $5,790 in 1906, but net earnings per mile of road were only $1,333, against $1,763 in the previous year. Per train mile, net earnings decreased from 52 cents in 1906 to 38 cents last year, a falling off of 27 per cent.—a result which eloquently bespeaks disorganization.

The cost of maintaining the way and structures increased 18 per cent. Per mile of road, maintenance of way cost $846, against $715 in 1906. However, although only 163 miles of the line are laid with heavier than 75-lb. rail, and 1,757 out of the 2,548 miles owned are laid with rail weighing 70 lbs. or less, there was a decrease in rail renewals. Maintenance of equipment as a whole increased 19 per cent. Repairs and renewals cost $2,143 per locomotive, against $2,061 in 1906; $829 per passenger car, against $705 in 1906, and $57 per freight car, against $55 in 1906. This is a case where increased unit maintenance of equipment charges do not represent any concealed equity, for although the average charges during the past year reach a fair average as compared with other roads, the Seaboard Air Line's equipment during the last two years has been in bad condition and larger expenditures are therefore necessary to accomplish the same results as can be obtained on other roads at smaller cost.

Under the head of conducting transportation there was a particularly large increase in the cost of fuel for locomotives, which cost 31 per cent. more than in 1906 and 59 per cent. more than in 1905. One of the disadvantages under which the Seaboard Air Line necessarily labors is that except on its Birmingham extension it reaches no coal mining regions, and therefore most of its fuel has to be carried considerable distances. All the items which are made up largely of wage payments also show large increases. Per diem payments were 97 per cent. larger than in 1906. Payments for freight lost and damaged increased 47 per cent., and for injuries to persons 79 per cent. The swift increase of the conducting transportation costs during the last winter is shown by the fact that with 91,000,000 tons carried one mile in November, 1906, the cost of conducting transportation was only $636,000, whereas in April, with only 89,000,000 tons carried one mile, the conducting transportation expense was $731,000.

A new general mortgage and collateral trust 30-year 5 per cent. bond issue amounting to $18,000,000 was authorized exactly a year ago. Of this issue $6,345,000 was sold. If it had been possible to sell the rest the company would probably have come safely through without a receivership, but sales later in the year were out of the question. An issue of $4,655,000 mortgage and collateral trust three-year 5 per cent. notes which matured on March 1, 1907, was extended to May 1, 1911. Three new car trust agreements were made September 26, 1906; May 16, 1907, and July 2, 1907. The total car trust payments during the fiscal year amounted to over $2,000,000.

The balance sheet shows the condition which forced the receivership of the company. On June 30 last, current assets, including over $2,000,000 material and supplies, amounted to $5,100,000, while current liabilities, including $3,900,000 in notes payable, amounted to $9,100,000. Since that time conditions have obviously been getting worse, for it has not been possible to issue any new securities, and earnings have been decreasing. According to the bill filed in application for the appointment of receivers, there was due on January 1, 1908, on bonds and equipment notes, $765,000, and for taxes, traffic balances, pay-rolls, supplies and other claims, $2,000,000, much of it overdue, besides floating indebtedness said to amount to about $3,000,000. To take care of the unsecured indebtedness is the first problem which must be solved in the reorganization. The receivers have been ordered to issue receivers' certificates with which to pay the amount due on bonds and equipment notes.

The best chance for the ultimate success of the property is a drastic reorganization which shall reduce the amount of the road's capital and simplify and unify its securities and its railroads. Then with an able and continuous management it should before many years come into its own. The interests represented by John Skelton Williams are actively co-operating in the receivership proceedings with the Ryan-Blair party who have controlled the road, and with this unity among the stockholders it should be possible to bring about this result.

The following table shows the results of operation for the last two years ended June 30 of the Seaboard Air Line Railway, not including the Atlanta & Birmingham Air Line, 237 miles; the Florida West Shore, 70 miles; the Tallahassee, Perry & Southeastern, 39 miles, and the Plant City, Arcadia & Gulf, 18 miles:

	1907.	1906.
Mileage worked	2,611	2,611
Passenger earnings	$3,786,540	$3,235,892
Freight earnings	11,438,312	10,775,580
Gross earnings	16,427,943	15,116,948
Maint. way and structures	2,205,998	1,865,540
Maint. of equipment	2,314,915	1,949,316
Conducting transportation	7,827,313	6,155,933
Operating expenses	12,948,042	10,513,461
Net earnings	3,479,901	4,603,487
Net income	458,301*	992,121
Net income, including Baltimore Steam Packet Co.	304,190*	1,131,578

*Deficit.

CONTRIBUTIONS

Final S in Walschaerts.

London, Dec. 18, 1907.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I notice in your issue of Nov. 29 a letter from Mr. F. W. Dean, of Boston, suggesting that the name of the inventor of the Walschaerts valve gear should be spelled without a final "s." Mr. Dean does not give any reason for the spelling he proposes, and the position he takes is quite untenable. If he will refer to your issue of December 8, 1905, page 493, he will find a translation of a short biography of E. Walschaerts, the inventor of the valve motion, written by Prof. M. J. Boulvin, of the University of Ghent. Prof. Boulvin, being a fellow countryman of Walschaerts, should certainly be an authority on the proper spelling of his name. Further, I have before me a quotation from the report of the Belgian members of the jury of the Paris Exhibition of 1878 which refers to the valve gear invented by Walschaerts and patented in 1844.

I think this is conclusive evidence as to the propriety of spelling Walschaerts with a final s. LAWFORD H. FRY.

Discipline Versus Accidents.

Omaha, Neb., Jan. 2, 1908.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Can the strong (?) arm of the law prevent railroad accidents?

The recent discussion of this subject in your magazine, ranging from conservative editorials to radical viewpoints of correspondents, is interesting to the students of the art of discipline. This is certainly one of the most important subjects connected with modern railroading, seemingly not confined to the United States, as our cousins on the north (the cold, deliberate Anglo-Saxon) are wrestling with it seriously, while the hot blooded sons of the Latin races on our southern border are frequently accused of chasing the erring engineer or conductor through the cactus and confining him in the old Spanish dungeons or burying him in the Government salt mines, for complicity in some accident which has resulted in loss of life.

Can we not profit by the history of human experience to evolve something that will really accomplish what we desire? Our railroad experience covers only a little over three-quarters of a century, while our general experience goes back into the Dark Ages of centuries past. The Chinese, for instance, have had a longer continuity of civilization than any other nation. The great struggle for existence makes the people of this great empire value human life less and to take a more serious view of business transactions than any other. They ought to be able to view a matter of this kind free from sentiment or prejudice. What would the Chinamen do under similar circumstances? These people are well behaved, law-abiding, economical, modest, industrious and studious as a whole. Incompetency or dishonesty is not tolerated in responsible positions. They are impatient of mistakes as being too serious a burden upon the public at large.

There is a story of a bank failure in China 300 years ago, the investigation of which resulted in the decapitation of every one connected with the institution from the porter up to the president; and no failure since.

We are inclined to the opinion that the Chinese will operate their railroads much the same, viz., exact from employees that for which they are paid—perfect service—and as a natural sequence they will not need to exact it—such service will come spontaneously out of the long heredity of that people; their very habits and characteristics must operate as a compelling force along the lines desired. This we have all witnessed or heard of in the admirable service rendered in menial capacity by the few Chinamen with whom we are acquainted—mostly Canton coolies, the descendants of the lowest classes, even criminals, sent over to this country during our pioneer railroad building to get rid of them. The more intelligent classes have an even better reputation for the higher sense of duty.

Coming back to our own country, take 2,000 young men out of any American rural district, divide them indiscriminately into two military regiments of 1,000 each, put in charge of one an officer who is a disciplinarian, who looks out for the comfort and interests of his men (perhaps it may be for a selfish motive entirely), but who exacts obedience until he is finally able to move this force as one unit at his will. At the head of the other regiment put an indifferent, lax commanding officer, who is kind to himself, cares but little what his men are doing in the idle moments, having as his motto, "Sufficient unto the day is the trouble thereof." Which of the two regiments would you choose to go up against in battle if you were on the other side?

We think it has been made plain that if you have a high sense of moral responsibility in your personnel you have the best material with which to operate; lacking in this, the next essential is to take what you can get and mold it into the best possible substitute. That is what must be done on the railroads in this country—drill, discipline, drill—until the forces at your command cannot exert an adverse force sufficient to prevent obtaining what is desired—good service. Moral suasion will not do it. Your force is not sufficiently placable. The majesty of the law will not do it, because your subject is a "sovereign." The law cannot prevent serious crimes that are undoubtedly on the increase under our criminal code. Then how can it compel service?

To err is human. There was only one perfect man. Mistakes will be made (regrettable as it may be) until the end of time. If hundreds of train crews and despatchers create hazards of accidents yearly, as they do, with the law taking cognizance of only those in which loss of life occur, where is the consistency? One must be as much of a crime as the other, the only difference being perhaps in the physical conditions or unfortunate adverse circumstances which bring about the fatality and for which the unlucky subject of legal investigation may not be in any way responsible. To punish an individual for destruction of property would lead to imprisonment for debt, petty persecutions and injustice. Who will draw the line, and where? To invite a higher degree of honor, of duty and loyalty will lead to a public sentiment that is stronger than the law in compelling that sense of personal responsibility requisite to perfect service. There should be certain infractions of the rules that require immediate and irrevocable dismissal, the most important of which are insubordination, disloyalty and dishonesty; with a distinct understanding that such offense cannot be discussed by grievance committees, further than, if necessary, to submit to them the proof.

The working forces should be well cared for and closely looked after. Reasonable recreation should be afforded them, and the temptation of the drinking places overcome by others equally attractive; then enforce rules against the use of intoxicants strictly. Place before employees in the train service information relative to their duties in such a way that they may be induced to enter into the operation of the road with a spirit of voluntary loyalty that is genuine.

Give some of your most efficient men, who have absolutely clear records, who are not agitators and who have by meritorious conduct shown that they are willing to render more service than they are paid for, a premium in the way of stock in the property. A few shares scattered here and there would have a wonderful effect in making watch dogs of the treasury. They should be held in escrow during the service of the employee, paid to his family immediately upon demise, or to himself on permanent retirement from the service; the profit sharing to be for exceptional service and at the discretion of the management. Leave something in the hands of the responsible operating official with which he can work to bring about results to his liking. Formerly he had the promotions or preferred runs to work on. This has been taken away by the schedules until now all stand on an equality, and there is nothing looked for or expected but punishment, with a well organized, paid force to contend against, prevent or undo discipline by coercion, argument or pleas for leniency. The monitors of the service are not now in evidence; their efforts to correct among themselves lax duty at present are made odious; to report an infraction of the rules is considered an offense on a par with treason, and one who practices it is liable to social ostracism, if not in danger of physical violence. The trainmaster cannot know all that he should unless information is obtained in this way—he finds it more difficult each day so to obtain it.

Last and most important of all and again is the drill. Anticipate accidents; prevent them by exacting the performances of duty with a military precision. All the indiscriminate forces on the railroad will contend against this—the public, traffic, the operating officials themselves and the employees. Delays will occur, trains will lose time while the drill is going on, but after the battle is won most of the difficulties will vanish and something will be gained. Surprise tests will accomplish wonders in this direction, and are the only things that will. Perhaps the selection of this term is unfortunate, as it gives the men an opportunity to allege the dangerous conditions under which they work and the possibility of personal injury from being "surprised." "Efficiency tests" would be the better expression, and all the term implies could be exacted to any extent desired.

Do not neglect those things which are beyond the control of the men; otherwise they will accuse you of insincerity. Throw every safeguard consistent with existing conditions around them and encourage suggestions from the men themselves along these lines. Too many officials do not know, and not knowing, fear discovery. To ward off such incompetency they assume that high and mighty bearing that chills those who do know, at least that which they do successfully each day, and from experience can possibly offer valuable suggestions.

With the installation of block signals and the operation of railroads along the above lines there will not be much left for the public to criticize—our methods will bear prospective governmental

investigation. While accidents will continue to occur, they will be classed as "accidents," and be accepted by the public as unavoidable risks of travel. At present they do not feel this way, and it is up to the railroad men of this country to correct it; the Law cannot do it—the railroad men can.

W. L. PARK,
General Superintendent, Union Pacific Railroad.

Rail Sections and Specifications.

Detroit, Mich., Dec. 31, 1907.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I agree with the article of E. W. Heinle of November 27. I wonder why the American Railway Association found it necessary to suggest experimental sections for rails lighter than, say, 80 lbs. per yard?

Perhaps it would be well for some road to try the new sections and see how they roll and how they wear before committing the railroads generally to a section which none of them know anything about.

J. D. HAWKS,
President and General Manager, Detroit & Mackinac.

Pittsburgh, Pa., Dec. 31, 1907.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Quoting from Robert Job's article read before the New York Railroad Club: "Twenty or thirty years ago steel rails did not cause the difficulty which is found with the present product. This is due to a number of causes. A vastly greater tonnage is handled to-day by the mills, and the same care is not used in the preparation and cropping of the ingots, while in rolling a much higher finishing temperature is maintained, resulting in a coarser structure with relatively rapid wear. In many cases the composition is better to-day than formerly, yet in spite of what, under present practice, would be considered dangerous composition, it is a well-known fact that the old rails gave generally excellent service, this being due largely to the thorough working of the steel down to a low finishing temperature. Some old 67 John Brown rails, rolled and laid in 1864, have been in track for 34 years. The composition was as follows: Carbon, .330 per cent.; phosphorus, .039 per cent.; manganese, .390 per cent.; sulphur, .030 per cent.; silicon, .070 per cent."

"An 80-lb. rail of somewhat the same composition, namely: Carbon, .396 per cent.; phosphorus, .072 per cent.; manganese, .660 per cent.; sulphur, .033 per cent.; silicon, .286 per cent., and rolled a few years ago, has a far greater coarseness of structure. Under the same traffic the one has given long service, while the other would cut out rapidly."

Mr. Job gives an exceedingly strong argument in favor of a greater number of passes in rolling rail section, if we expect to secure a good rail, in fact, the strongest that has yet been advanced; although he does not say that a greater number of passes will accomplish this result, but if anyone will take the trouble to look up the record of the John Brown mill, they will find that there was used in rolling the No. 67 rail not less than the 25 passes advocated by me; more likely a greater number of passes than these were used.

Mr. Job also corroborates an assertion made by me—although he does not seem to realize that a greater number of passes will do this—that if a greater number of passes were used the carbon content could be reduced. He shows that the John Brown rail was but .330 carbon, and yet the rails were better than the ones rolled to-day with over .50 carbon. What stronger argument does one need than this? Here is one of the foremost metallurgists of the age coming forward and saying that rails rolled 40 years ago with chemical conditions, that to-day would be considered dangerous, are better than rails rolled at the present time, with the best metallurgical conditions that can be secured, and he is right. The answer to it all is, better mechanical treatment of the steel in the earlier days than prevails under present mill practice.

The only way to get rails finished at a low temperature without excessive strain and great disturbance of the molecular structure is to use more roll passes and less reduction per pass. This is a mechanical condition, and metallurgy cannot control it.

If it takes an average of 8 or 9 minutes to roll a finished rail from the ingot with 15 passes, as claimed by F. E. Abbott, of the Lackawanna Steel Co., how are we to get rails finished at a lower temperature than at present, if no more passes are used? Mills cannot give us any lower temperature at the initial pass, and roll the rails with the present reduction; their machinery is not strong enough. Nearly every break of machinery that occurs in rolling mills to-day comes from a delayed piece of steel that has become so cold that the reduction cannot be given without breakage of rolls or other mill parts.

Now what is to be done? Build a mill strong enough to crush the life out of the steel in a few passes at a low temperature, or put in more sets of rolls, thereby getting more passes, allowing the rolling to be done at a minimum reduction per pass, and get a rail approaching the condition so much desired by everybody? That is, a close-fibered, tough, homogeneous body of steel as nearly approaching the condition of cold rolled shafting as is practicable.

S. T. FIERO,
Inspecting Engineer.

The Influence of Heat Value and Distribution on Railroad Fuel Cost.*

The cost of locomotive fuel is about 12 per cent. of the total operating expenses of a railroad, consequently the subject of fuel economy is of the utmost importance. It is not the purpose of this paper to discuss the economical use of coal on locomotives, but to deal with the economical purchase and supply of coal before it reaches the locomotives. In order that coal may be economically purchased and distributed the heat value and cost must be considered. The heat value of coal may be determined by laboratory calorimeter tests or by evaporation tests made on locomotives. The latter method is preferable, as the coal is tested in actual service.

Locomotive Coal Tests.—The heat values of the coals found on or near the railroad system which are being or are likely to be used, should be determined by locomotive evaporation tests. The coals should be tested in groups, and in order that different groups of coals may be compared, even though the tests are made 1,500 miles apart, each group of tests as well as the individual tests should be carried on under similar conditions.

The unit of comparison for coals is the number of pounds of equivalent water evaporated per pound of coal. It is evident that the following items will affect this ratio or unit of comparison: Kind of coal; class of engine; condition of engine; engine crew, especially the fireman; class of service. Since the object of coal tests is to determine the comparative value of various coals, all others of the above conditions should be kept as uniform as possible.

Coals should be tested on a division where they are being used, as the firemen are already accustomed to them. When coals which differ materially from those habitually used are to be tested, a number of trial runs must be made until the firemen can fire the coal properly.

If possible, all the tests made on one railroad system should be made on one class of engine. This is advisable in order that the coals tested at one end of the system can be compared with those tested at the other end without having to correct for the difference in evaporative efficiencies of the engines.

The engines should always be in good condition; this applies especially to condition of flues and firebox. Whether a brick arch is used or not, the conditions in this particular should be the same in all tests.

During a series of tests the same firemen should be used throughout, thus avoiding any difference on this account. It is not so important that the same engineers be used, for while one engineer may use more steam than another, the ratio of the coal to the water used will not change materially.

Passenger service is preferable to freight on account of the more uniform conditions. It is desirable that the time between terminals, the time using steam and the weight of the trains shall be nearly uniform from day to day, and that the average of these values for all tests made with each kind of coal shall be nearly the same. When tests are conducted in freight service, at least twice the length of time will be required to test one kind of coal, and the expense will be more than doubled on account of additional coal weighers being required.

At each terminal a fuel tester is located to take charge of the supply and weighing of the test coal and to see that none of the weighed coal on the engine is used during its stay at the terminal. The coal weigher is relieved by an engine observer before the engine leaves the roundhouse, and he stays with the engine until relieved by the coal weigher at the other terminal. The engine observer keeps record of coal, water, steam pressures, stops, shut-offs, etc., in a printed thumb-indexed note book made up of seven printed forms and three blank pages. From four to eight men are required to make the tests properly, according to whether one or two engines are used and whether they are single or double crewed.

Exclusive of that used for firing up, about 150 tons of each kind of coal should be used on the tests. From six to eight round trips are made with each coal, and where two firemen are used, half the tests are made with each fireman. This is necessary, as one fireman might be slightly better than another. Tests in one direction on account of grades, speed or number of cars may be more favorable than in the other, hence the same number of trips in each direction is necessary.

The data taken for each test are recorded on the blanks already mentioned, and the more important totals and averages are recorded on a "final result" sheet. The data and computations of each test are recorded in a column and the average for all tests in an "average" column. In a series of tests which have all been conducted under similar conditions, the heat value of each coal is pro-

*A paper presented at the November meeting of the Western Railway Club by J. G. Crawford, Fuel Engineer of the C., B. & Q. Ry.

portional to the average of the items showing the equivalent number of pounds of water evaporated from and at 212 deg. per pound of coal.

The results covering the A. B. C. Railroad will be expressed as follows:

Name of coal.	Equiv. evap. per lb. coal; actual.	Rank, per cent.	Price, per ton.	Name of coal.	Equiv. evap. per lb. coal; actual.	Rank, per cent.	Price, per ton.
A	5.60	80	$1.50	F	7.00	100	$1.10
B	5.60	80	1.30	G	7.70	110	1.40
C	6.30	90	1.30	H	7.70	110	1.20
D	6.30	90	1.60	I	8.40	120	2.10
E	7.00	100	1.30	J	8.40	120	2.50

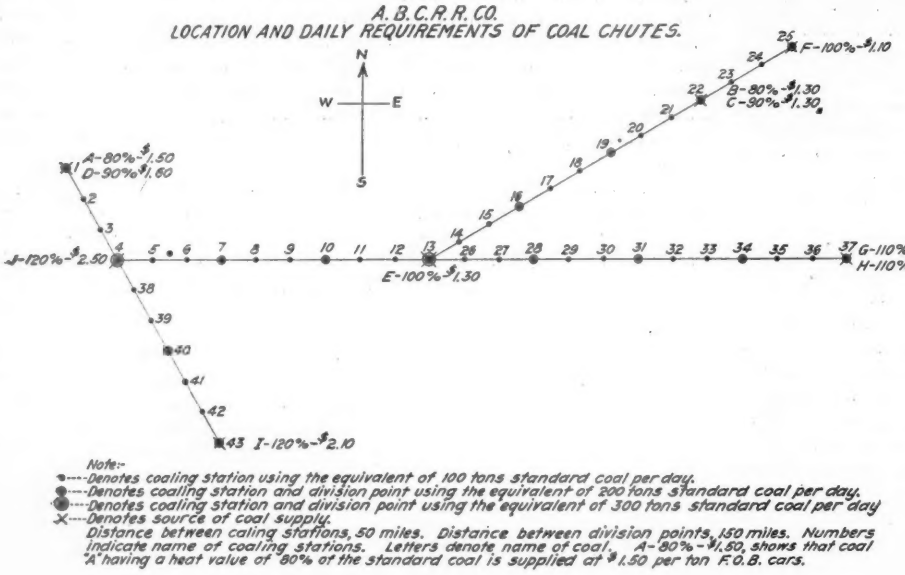

A. B. C. R. R. CO.
LOCATION AND DAILY REQUIREMENTS OF COAL CHUTES.
N
W
E
S
A-80%-$1.50
D-90%-$1.60
J-120%-$2.50
E-100%-$1.30
B-80%-$1.30
C-90%-$1.30
F-100%-$1.10
G-110%-$1.40
H-110%-$1.20
I-120%-$2.10
Note:-
Denotes coaling station using the equivalent of 100 tons standard coal per day.
Denotes coaling station and division point using the equivalent of 200 tons standard coal per day.
Denotes coaling station and division point using the equivalent of 300 tons standard coal per day
Denotes source of coal supply.
Distance between caling stations, 50 miles. Distance between division points, 150 miles. Numbers indicate name of coaling stations. Letters denote name of coal. A-80%-$1.50, shows that coal "A" having a heat value of 80% of the standard coal is supplied at $1.50 per ton F.O.B. cars.

Fig. 1.

The above coals do not necessarily represent individual companies or mines, but coals of equal heat value and price from the same point of distribution are included under one name. For convenience the coals have been assumed to be poorer and better than the standard coal by multiples of 10 per cent. The prices selected in most cases bear little or no relation to the heat value, which is true under actual conditions.

For convenience the A. B. C. Railroad, as shown in Fig. 1, has been assumed as having the following requirements and conditions:

(1) Coaling stations require respectively the equivalent of 100, 200 and 300 tons of standard (100 per cent.) coal per day.

(2) The railroad can get as much coal as it desires from all the sources of supply.

(3) All these coals will mix with each other without additional trouble from clinkering.

(4) Cost of handling at chutes, 10 cents per ton.

(5) Cost of haulage from source of supply to chute, 2 mills per ton-mile. (Under the accounting system put in force by the Interstate Commerce Commission on July 1 no charge is made against the fuel account for the haulage of coal on a company's own line. This has been the practice, at least on the more important lines, for a number of years past; although about 1901 at least two of the important systems charged their fuel account with the haulage of company coal at the rates of 3 and 5 mills per ton mile, respectively. Whether or not the haulage of company coal on a company's own line is, or is not, charged to the fuel account, is a matter of no importance, as the cost remains the same in either case, but in order to work out the best coal distribution it is a matter of the utmost importance to accurately know this cost of haulage. The above rate of 2 mills per ton-mile is probably too low in most cases, but is selected at this figure to simplify the computations to follow.)

Competitive Points.—The prices and heat values of the coals have been so selected that they illustrate a number of combinations that arise in practice which will be taken up under the following headings:

Equal Heat Value, Unequal Price and Same Source of Supply.—Coals G and H having the same heat value, and being supplied from the same point should cost the same. As $1.40 per ton is asked for G and $1.20 for H, G should not be used, and thus is eliminated from consideration.

Equal Heat Values, Unequal Price and Different Sources of Supply.—Coals J and I, Fig. 2, have the same heat value, and J is supplied at $2.50 per ton from station No. 4, 300 miles from station No. 43, where I is supplied at $2.10 per ton.

The dividing line between coals J and I, which is called the competitive point, is found from the following equation in which x is the distance from station No. 4 to the competitive point.

$$\frac{\$2.50 + \$0.10 + x\ (\$0.002)}{120 \text{ per cent.}} = \frac{\$2.10 + \$0.10 + (300 - x)\ \$0.002}{120 \text{ per cent.}}$$

$x = 50$ miles.

This shows that at all points north of station No. 38 J coal should be used; south of station No. 38 I coal should be used, and

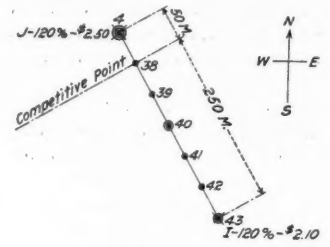


Fig. 2.

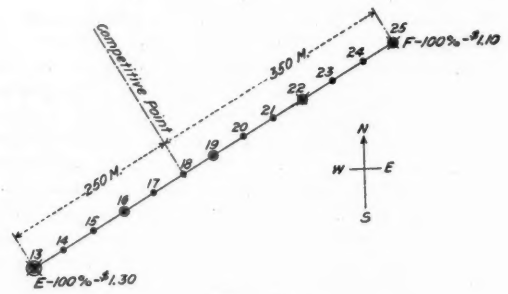


Fig. 3.

at station No. 38 either I or J coal can be used, as both will cost $2.70 on the engine at that point, made up as follows:

	Coal J. No. 4	Coal I. No. 43
F. o. b. station		
First Cost	$2.50	$2.10
Haulage	.10	.50
Handling at chuts	.10	.10
Cost on engine per ton	$2.70	$2.70
Cost on engine of amount equivalent to 1 ton standard coal.	2.25	2.25

Coals E and F, Fig. 3, have also the same heat value and are from different sources of supply.

The equation for finding the competitive point of these coals is as follows:

$$\frac{\$1.30 + \$0.10 + x\ (\$0.002)}{100 \text{ per cent.}} = \frac{\$1.10 + \$0.10 + (600 - x)\ \$0.002}{100 \text{ per cent.}}$$

$x = 250$ miles.

This shows that at station No. 18 both coals cost the same, made up as follows:

	Coal E. No. 13	Coal F. No. 25
F. o. b. station		
First cost	$1.30	$1.10
Haulage	.50	.70
Handling at chute	.10	.10
Cost on engine	$1.90	$1.90

Unequal Heat Values, Equal Price, Same Source of Supply.—Coals B and C, costing the same, are supplied from the same source, but B is an 80 per cent. and C a 90 per cent. coal. As C is 12½ per cent. better than B, C should be used and B excluded.

Unequal Heat Values, Unequal Prices, Same Source of Supply.—Coals A and D are supplied from the same source, but are different in both heat value and price, A being an 80 per cent. coal costing $1.50 per ton, and D being a 90 per cent. coal costing $1.60 per ton. D being 12½ per cent. better than A, and costing only 6⅔ per cent. more, should be used to the exclusion of A.

Unequal Heat Values, Unequal Prices and Different Sources of Supply.—Coals D and J, Fig. 4, are unequal in heat value and price and are supplied from different points. Their competitive point would be found as follows:

$$\frac{\$2.50 + \$0.10 + x\ (\$0.002)}{120 \text{ per cent.}} = \frac{\$1.60 + \$0.10 + (150 - x)\ \$0.002}{90 \text{ per cent.}}$$

$x = 14.3$ miles.

The competitive point of coals D and J is 14 miles north of J, therefore stations No. 1, No. 2 and No. 3 should be supplied with

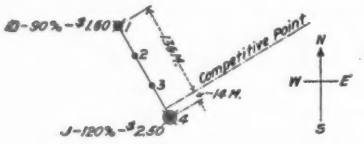


Fig. 4.

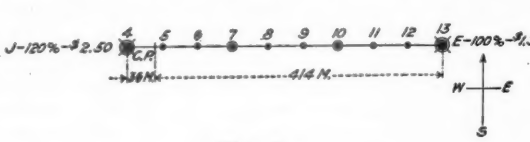


Fig. 5.

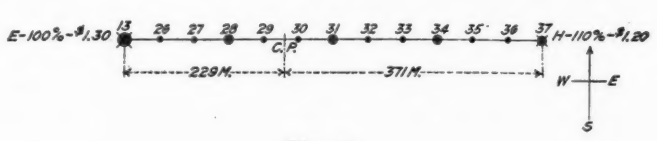


Fig. 6.

D, and station No. 4 with J. At the competitive point coal on the engine would cost as follows:

	Coal D. No. 1	Coal J. No. 4
F. o. b. station	$1.60	$2.50
First cost	.27	.03
Haulage	.10	.10
Handling at chute		
Cost on engine, per ton	$1.97	$2.63
Cost on engine of amount equal to 1 ton standard coal	2.19	2.19

The competitive point of coals J and E, Fig. 5, is found from the following equations:

$$\frac{\$2.50 + \$0.10 + x\ (\$0.002)}{120\text{ per cent.}} = \frac{\$1.30 + \$0.10 + (450 - x)\ \$0.002}{100\text{ per cent.}}$$

$$x = 36.4 \text{ miles.}$$

This shows that J coal cannot be used east of station No. 4 and that E coal should be used at stations No. 5 to No. 13 inclusive. At the competitive point coal on the engine would cost as follows:

	Coal J. No. 4.	Coal E. No. 13
F. o. b. station	$2.50	$1.30
First cost	.07	.83
Haulage	.10	.10
Handling at chute		
Cost on engine, per ton	$2.67	$2.23
Cost on engine of amount equal to 1 ton standard coal	2.23	2.23

The competitive point of coals E and H is determined by the following equation, as shown in Fig. 6:

$$\frac{\$1.30 + \$0.10 + x\ (\$0.002)}{100\text{ per cent.}} = \frac{\$1.20 + \$0.10 + (600 - x)\ \$0.002}{110\text{ per cent.}}$$

$$x = 229 \text{ miles.}$$

E coal is thus limited to station No. 29 and west thereof and H coal from stations No. 30 to No. 37 inclusive. At the competitive point the following would be the cost of coal on the engine:

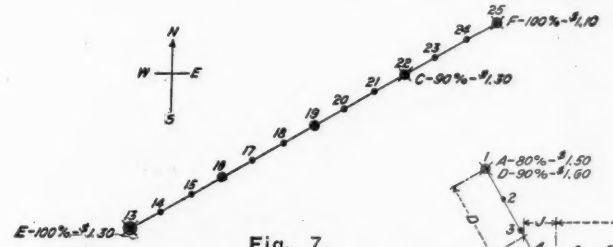


Fig. 7.

	Coal E. No. 13	Coal H. No. 37
F. o. b. station	$1.30	$1.20
First cost	.46	.74
Haulage	.10	.10
Handling at chute		
Cost on engine, per ton.	$1.86	$2.04
Cost on engine of amt. equal to 1 ton standard coal	1.86	1.86

The competitive point of coals C and F, Fig. 7, is found from the following equation:

$$\frac{\$1.30 + \$0.10 + x\ (\$0.002)}{90\text{ per cent.}} = \frac{\$1.10 + \$0.10 + (150 - x)\ \$0.002}{100\text{ per cent.}}$$

$$x = 13.2 \text{ miles.}$$

Note that x is a negative quantity which shows that F can be hauled 26.4 miles more than the above 150 miles and then cost the same on the engine at station No. 22, the point of distribution of C, as the amount of C coal equivalent to one ton of standard coal. This is proven by the following table:

	Coal C. No. 22	Coal. F. No. 25
F. o. b. station	$1.30	$1.10
First cost	.00	.30
Haulage	.10	.10
Handling at chute		
Cost on engine, per ton	$1.40	$1.50
Cost on engine of amount equal to 1 ton standard coal	1.55	1.50

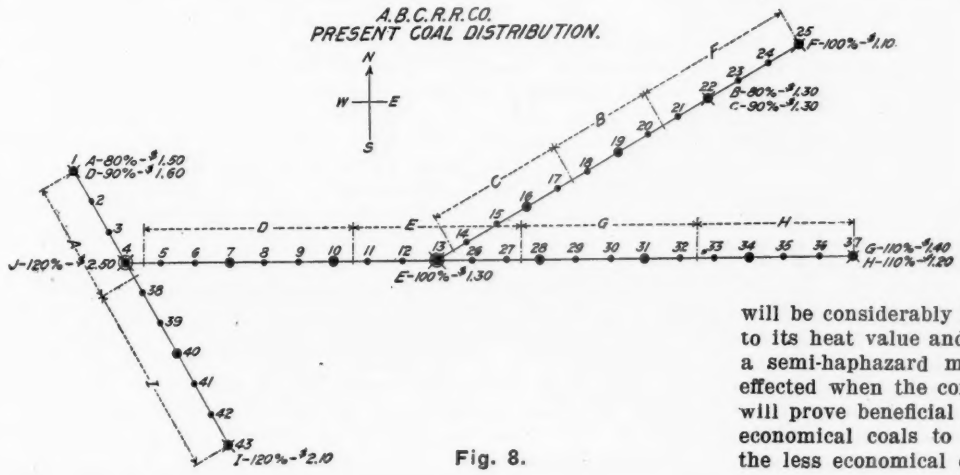


Fig. 8.

Present vs. Proposed Coal Distribution A. B. C. R. R.—The present coal distribution on the A. B. C. Railroad is shown by Fig. 8 and the proposed distribution by Fig. 9. Some objection may be offered to the distribution shown in Fig. 8, but when it is considered that the relative heat values are not known before tests have been made the distribution is not an improbable one.

The cost of fuel per day under the present system of coal distribution, and that of the proposed distribution, are shown in two large tables not reproduced here. The following totals, made up from these tables, show the amount of each kind of coal used under the present and proposed distributions:

Kind of coal	Present distribution: Tons used.	Present distribution: Equivalent to following tons of standard coal.	Proposed distribution: Tons used.	Proposed distribution: Equivalent to following tons of standard coal.
A	875.0	700	.....	.....
B	500.0	400	.....	.....
C	555.5	500	.....	.....
D	888.8	800	444.4	400
E	700.0	700	2,300.0	2,300
F	700.0	700	1,100.0	1,100
G	636.3	700	...	.....
H	636.3	700	999.9	1,100
I	666.4	800	583.1	700
J	...	...	333.3	400
Total ...	6,158.3	6,000	5,760.7	6,000

Below are given the averages and totals of these tables, and the savings to be made by adopting the proposed distribution:

Coal: Distribution.	Tons.	Average: Haulage.	Tn-miles.	First cost.	Cost of coal: Haulage.	Handling.	Total.
Present	6,158.3	176	1,084,035	$8,840.55	$2,168.07	$615.83	$11,624.45
Proposed	5,760.7	136	783,140	8,058.68	1,566.28	576.07	10,201.03
Difference	397.6	40	300,895	$781.87	$601.99	$39.76	$1,423.42

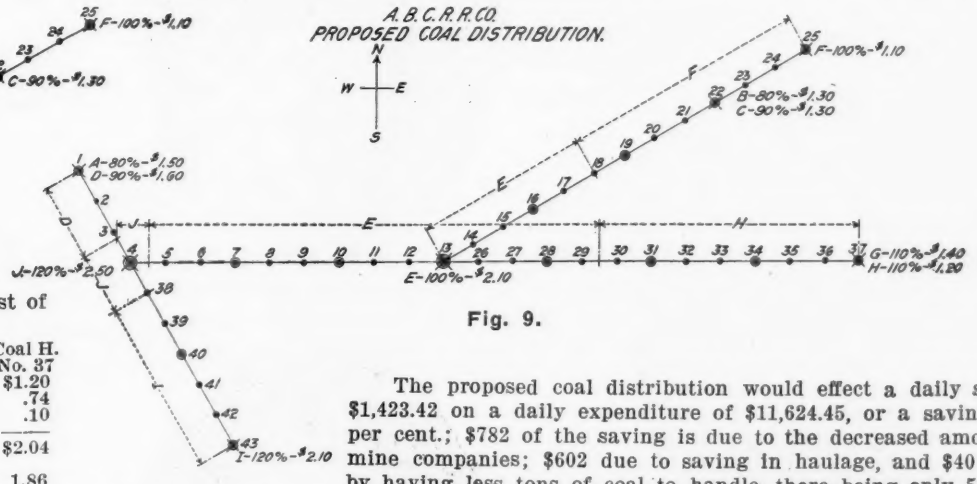


Fig. 9.

The proposed coal distribution would effect a daily saving of $1,423.42 on a daily expenditure of $11,624.45, or a saving of 12.2 per cent.; $782 of the saving is due to the decreased amount paid mine companies; $602 due to saving in haulage, and $40 is saved by having less tons of coal to handle, there being only 5,761 tons of coal used daily under the proposed distribution as against 6,158 tons under the present distribution. The table also shows the decrease in the average length of haul and the decrease in total ton-miles. It is not expected that every railroad company in working out a coal distribution would find that a saving of over 12 per cent. could be made by distributing the coal according to the methods herein outlined, but there is no doubt that considerable saving is to be effected on most systems.

The relative importance of fuel and oil economy has often been mentioned, but by way of comparison it may be said that a saving of less than 2 per cent. in the fuel bill would pay for the entire amount of oil and waste used for locomotive lubrication, and many railroads can save several times the amount of the lubrication bill by perfecting their system of coal purchase and distribution. During the last fiscal year the average cost of fuel for locomotives and lubrication for locomotives on five leading western roads was as follows:

		Per cent.
Fuel for locomotives	$6,042,266	13.2
Lubrication for locomotives	148,160	0.3
Total operating expenses	45,604,820	....

This shows that the cost of lubrication of locomotives amounts to only 2.5 per cent. of the cost of fuel for locomotives and that at least 40 times the energy that is now spent in reducing the cost of lubrication should be expended on the fuel item.

It is not expected that any railroad can at all times distribute coal according to some predetermined plan, but the cost of fuel will be considerably less, when purchased and distributed according to its heat value and cost, than when purchased and distributed in a semi-haphazard manner. The greatest saving can probably be effected when the commercial demand is not at a maximum, which will prove beneficial to purchase and distribution by allowing more economical coals to be used and correspondingly less amounts of the less economical coals.

The Block Signal and Train Control Board.

The portraits shown on this page are those of the members of the "Block Signal and Train Control Board" which, acting under the authority of the Interstate Commerce Commission, is charged with the duty of investigating the subject of automatic train stops and other block signaling questions. The appointment of this board, under authority of a Congressional resolution, was noticed in the *Railroad Gazette* of July 19, last, page 58. The Chairman of the board is Professor Cooley, Dean of the Engineering School of the University of Michigan. He has been connected with that institution since 1885, previous to which time he was in the United States Navy. Professor Cooley has done expert engineering work in connection with railroads for the state of Michigan and for the city of Chicago.

Captain Ames is Signal Engineer of the Electric Zone of the New York Central & Hudson River, and has served on the Lake Shore & Michigan Southern and Boston & Albany, as well as on different divisions of the New York Central. His title as Captain comes from his service in the Engineering Corps of the United States Army during the war with Spain in 1898.

Mr. Ewald is Consulting Engineer of the Illinois Railroad and Warehouse Commission, and was formerly in the Engineering Department of the Atchison, Topeka & Santa Fe.

Mr. Adams is associate editor of the *Railroad Gazette*.

Concerning the work of this Board, the Commission, in its annual report, says that its attention has thus far been directed to an examination of inventions that have been presented in response to a circular letter issued by the Commission. Continuing, the Commission says: "As the block system proper is now in general use and information concerning it can be obtained with comparative ease the board has devoted its attention mainly to the question of automatic stops. In considering the desirability of such devices on railroads generally one of the first problems to be solved is the reliability of the apparatus when its operation is interfered with by snow, ice or accidental disturbances or obstructions. Another problem is the arrangement and regulation of the apparatus so as to provide against failure or inconvenience and delay caused by such irregularities as unusually long or short trains, varying rates of speed, train movements in the reverse direction, and the unexpected stoppage of trains.

Azel Ames, Jr.

M. E. Cooley.

B. B. Adams.

F. G. Ewald.

"The questions to be determined by test are, first, the merit when used in general service of those devices which are already in use in exceptional situations, and, second, what merit there may be in the large number of inventions and alleged inventions which have not yet been developed and installed. Concerning the first class a number of concerns are now proposing to make experimental installations, and these, if ready, will be inspected by the board during the coming winter. As to the second class, all but a few of the devices that have been presented for consideration are from inventors who have little knowledge of the present state of the art of signaling and who appear to have taken little pains to secure the counsel of men experienced in railroad operation.

"The use of automatic stops necessitates special equipment on each engine traversing the line where the stops are installed. This is a radical innovation and involves questions which must be considered with great care. There are two principal methods of communication with the engine, namely, by mechanical trips and by electrical contacts. The relative desirability and reliability of these methods is one of the first questions to be settled. Under this head it will be desirable to investigate certain cab-signal installations in Europe, some of which are of ten years' standing. Cab signals are not automatic train stops, but they use either the mechanical trip or electrical contact in the same way that an automatic stop would use it, hence the need of learning the lesson of this European experience through a visit by a member of the board or some other competent person to England and France.

"Up to date the board has examined descriptions of 495 devices or systems; 245 of this number have been laid aside as not coming within the terms of the joint resolution. They deal with devices intended to improve the condition of tracks, automatic car couplers, automatic steam and air hose couplers, safety cars, etc. Of the remaining inventions the board has been furnished with descriptions of 175 which relate directly to block signals, cab signals, or automatic train stops; 55 of this number have already been disposed of and 120 are now in the course of examination. In nearly all of the 55 cases which have been passed upon the board has unanimously decided that the alleged inventions have not sufficient merit to warrant further attention. In most of these cases the plans and specifications that have been furnished indicate that the inventors are manifestly unacquainted with the requirements of railroad service, their devices being merely repetitions of what has been previously invented."

Mallet Compound Locomotive for the Central of Brazil.

The American Locomotive Co. has recently built three Mallet articulated compound locomotives for the Central Railroad of Brazil, which, while not ranking in size and capacity with those built by the same company for the Baltimore & Ohio and Erie, are still of goodly proportions and have a capacity on a par with the heaviest consolidation locomotives in use on American roads. In general design the type built resembles the Erie engine, except that it is fitted with three pairs of driving wheels in each truck instead of four pairs. The boiler is rigidly attached to the rear frame and the flexible connections to the front cylinder and the exhaust are the same as those shown in the *Railroad Gazette* Oct. 4, 1907.

As in the case of the other locomotives the Walschaerts valve gear is used. There is one detail to which attention may be called, and that is the comparatively low position of the injector check. It will be seen to be just above the top of the main air reservoir and well down below the center line of the boiler, showing that despite all of the discussion on the subject that has appeared during the last year or so, the position of the part has not yet been definitely settled.

The following are some of the principal dimensions of these engines:

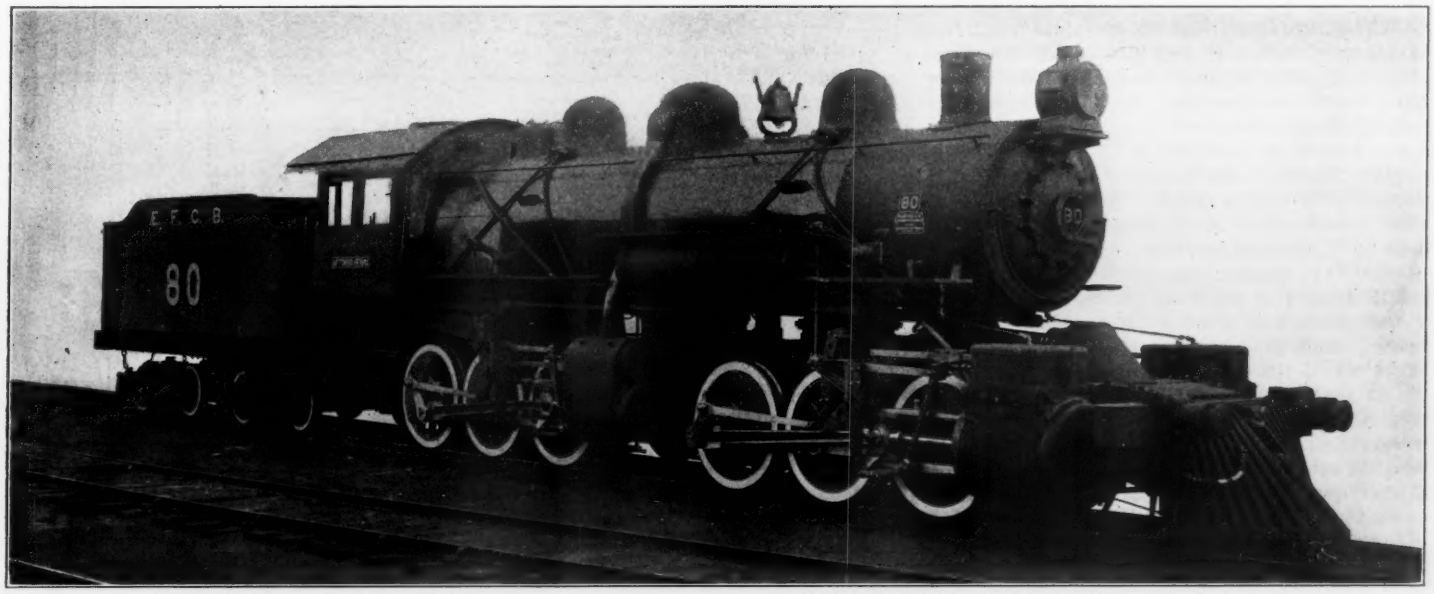
Cylinders, diameter, h. p.	17½ in.
Cylinders, diameter, l. p.	28 "
Piston stroke	26 "
Track gage	5 ft. 3 "
Wheel base, rigid	9 " 0 "
" " total	27 " 8 "
" " engine and tender	55 " 2¼ "
Weight on drivers	206,000 lbs.
Weight, engine and tender	304,300 "
Heating surface, tubes	2,195.2 sq. ft.
" " firebox	121.5 "
" " total	2,316.7 "
Grate area	41.0 "
Journals, engine	7½ in. x 9 in.
Journals, tender	5 " x 9 "
Steam pressure	200 lbs.
Fuel	Cardiff coal
Firebox, length	90⅛ in.
" width	63¼ "
" thickness crown, sides, back sheets	⅜ "
" thickness tube sheet	½ "
" water space, front	5 "
" water space, sides and back	4 "
Tubes, material	Charcoa' iron
" number	234
" diameter	2 in.
" length	18 ft.
Brake	Westinghouse
Stack, height above rail	13 ft. 9½ in.
Tank, style	Water bottom
" capacity, water	4,500 gals.
" capacity, fuel	8½ tons
Valves, h. p.	Improved Piston
" h. p. travel	5 in.
" h. p. lap	⅞ in.
" l. p.	Allen-Richardson
" l. p. travel	5½ in.
" l. p. exhaust clearance	3-16-in.
" lead	3-16-in.
Wheels, diameter, driving	50 in.
Wheels, diameter, tender	30 "
Wheels, type, tender	Rolled steel, 2-in. rim.
Tractive power	42,420 lbs.

$$\frac{\text{Weight on drivers}}{\text{Tractive power}} = 4.85$$

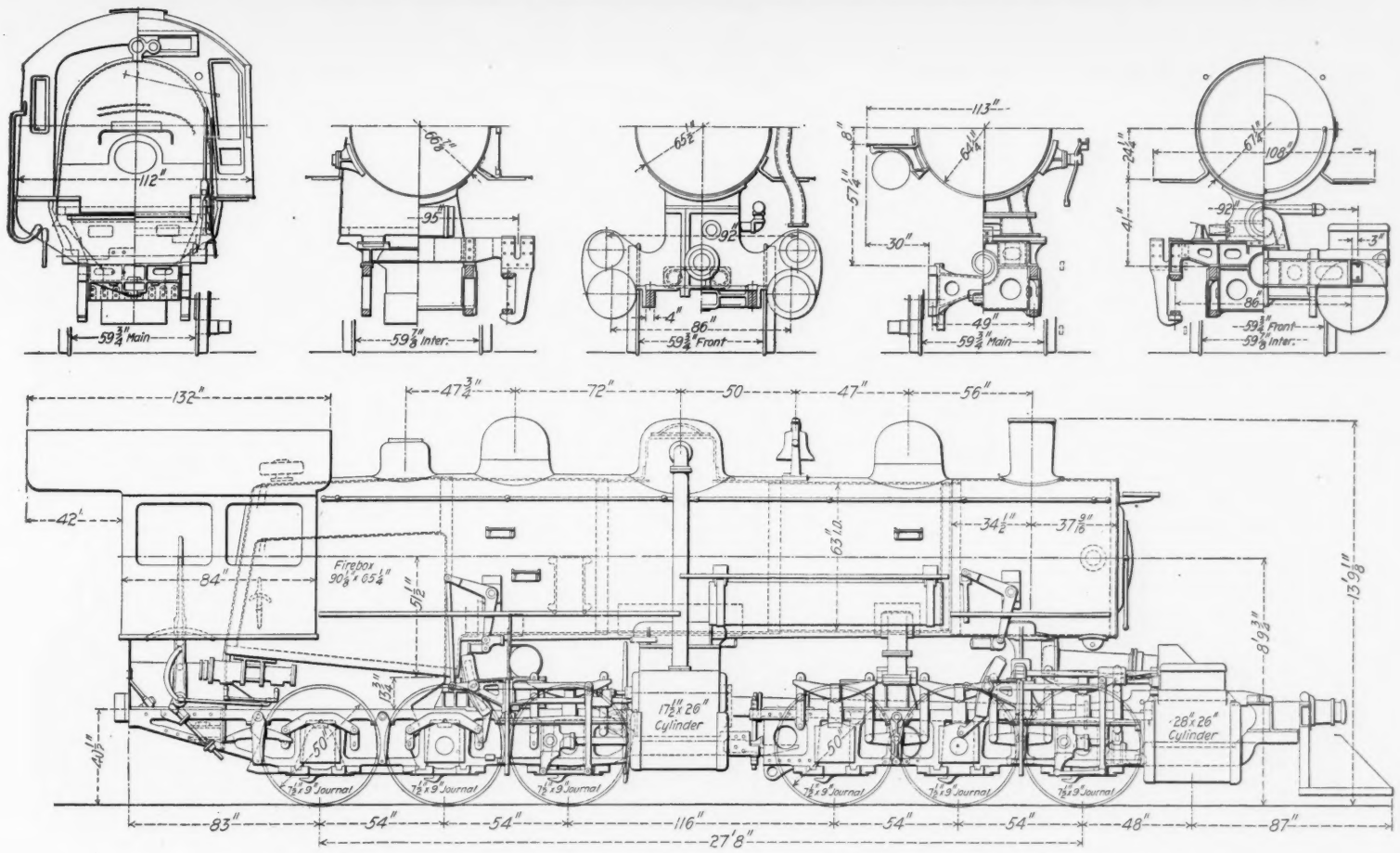
$$\frac{\text{Tractive power x diameter drivers}}{\text{Heating surface}} = 924.16$$

$$\frac{\text{Heating surface}}{\text{Grate area}} = 56.50$$

$$\frac{\text{Firebox heating surface}}{\text{Total heating surface}} = 5.25^*$$



Mallet Articulated Compound Locomotive; Central Railroad of Brazil.



General Elevation and Cross Sections; Mallet Compound for Central Railroad of Brazil.

$\frac{\text{Weight on drivers}}{\text{Total heating surface}}$ =	88.92
Volume of 2 h. p. cylinders, cu. ft. =	7.24
$\frac{\text{Total heating surface}}{\text{Volume 2 h. p. cylinders}}$ =	333.8
$\frac{\text{Grate area}}{\text{Volume 2 h. p. cylinders}}$ =	0.057
$\frac{\text{Area l. p. cylinder}}{\text{Area h. p. cylinder}}$ =	2.56
Tube heating surface equated to firebox heating surface (Vaughan formula), sq. ft.	517.73
Total equated firebox heating surface, sq. ft.	639.23
$\frac{\text{Total actual heating surface}}{\text{Equated firebox heating surface}}$ =	3.62

*Per cent.

The Galesburg Timber Preserving Plant of the Burlington.

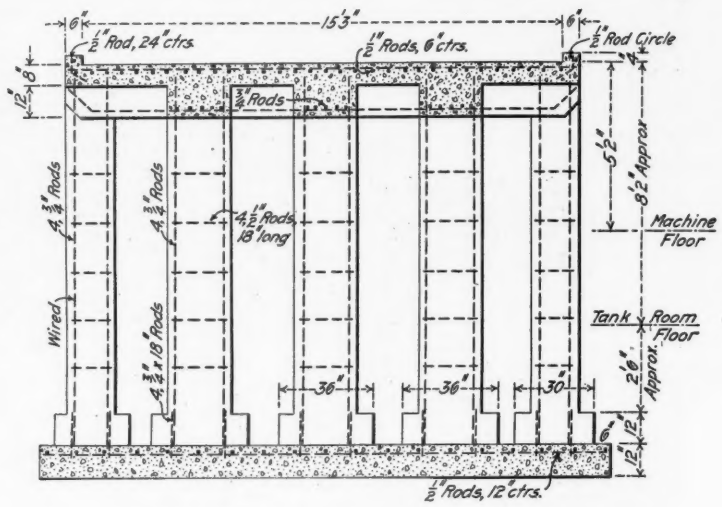
The Chicago, Burlington & Quincy built its first timber preserving plant in 1900. It was located at Edgemont, S. Dak., for treatment of Oregon fir and mountain pine cut in the vicinity. This plant, which was described in the *Railroad Gazette* of April 6, 1900, used the Burnettizing and Wellhouse processes. The following year it was moved to Sheridan, Wyo., to be nearer the sources of timber supply. There it has been in operation ever since. Its capacity is only 350,000 ties a year. The Burlington lately determined to build another and much larger plant embodying the most recent ideas in timber preservation. As the timber to be treated was the inferior oak, maple, gum, pine and other soft woods, coming principally from the southern states, the logical place for the location of the plant was some point in Illinois reached by the lines extending southward in that state. The plant was put at Galesburg where all of the lines in Illinois center.

A large new freight yard, described in the *Railroad Gazette* of Sept. 8, 1905, was built at Galesburg about a year ago. The timber preserving plant is located southwest of this yard on a cut-off built from its south end, which is adjacent to the Kansas City line, across to the Omaha line. The plant is about four miles from the city, on an 80-acre tract. There is storage space for 1,500,000 ties, which is the yearly capacity of the plant. There is also space for a considerable amount of piling and bridge timber. The tract is rectangular in shape and the storage yard is laid out with nine parallel sets of tracks, the three northerly of which will not be built at present. Four of the tracks are laid with three rails for narrow and standard gage cars.

The main building, which is 152 ft. x 115 ft. and has retort, engine, boiler and tank rooms, is built of reinforced concrete. The beams, roof and floor are crushed stone concrete of a 1:2:4 mixture, and the walls and foundations are gravel concrete of an equivalent 1:2:6 mixture. The side walls are 5 in. thick and reinforced with ½ in. corrugated steel bars, spaced 18 in. centers both ways. The floors, where reinforced, are in 15-ft. x 30-ft. panels with ½-in. corrugated bars spaced 3 in. by 8 in. on centers, every other bar being arched over the beam. The roof has ½ in. bars spaced 6 in. by 12 in. It was mopped with pitch and covered with a four-ply composition roofing. The retort room is ventilated with two monitors each 10 ft. wide and 30 ft. long made entirely of concrete. Their windows, and all others in the building, have steel sash and wire-glass lights.

In excavating for the building, water was encountered at a depth of 5 ft. This modified the method of erection somewhat. After putting in the foundation walls, the pilasters were built first and the intervening wall panels put in afterward suitably keyed to the pilasters. This was because of the possibility of unequal settlement between the loaded pilasters and the unloaded wall panels and was done to avoid cracking.

The retort room is 152 ft. long and 38 ft. wide. There are three retorts 132 ft. long and 6 ft. in diameter, made of ⅞-in. steel, with a capacity of 400 ties to the charge. The plant capacity per 24-hour day is 5,000 ties. The plant is equipped for either the Card, Rueping or Burnettizing process. The second and third of these have been fully described heretofore. The Card process is the zinc-creosote (Rutger) process adapted for use in this country at reasonable cost by an efficient and inexpensive method of agitating the mixture under pressure. Unless this is done, the use of a special imported oil is necessary to get a mixture that will not separate under pressure. In the Card process a centrifugal pump is used, with suction and discharge connected respectively to the top and bottom of the treating cylinder. The discharge pressure is dis-



Reinforced Concrete Foundation for Tank.

tributed uniformly throughout the length of the cylinder by means of a perforated pipe. The pressures on the two sides of the pump are equalized, being the same as the cylinder pressure, and little power is needed to handle large quantities of the mixture. Thorough agitation is obtained and enables the use of any good grade of oil with the zinc chloride regardless of their respective specific gravities. Impregnation is effected at a pressure of 180 lbs.

The boiler room, which is 46 ft. square, has three 150-h.p. boilers, one of which is extra for emergency use. The boilers are equipped with an induced draft system. The engine room, 30 ft. x 115 ft., contains an air compressor, fire pump, electric generator, three pressure pumps and an oil pump, with ample room for additional machinery. The valves for controlling the fluid in the headers in the basement also are worked from this room and all gages are under the eye of the engineer.

In the tank room, 39 ft. x 56 ft., is a 50,000-gal. steel working

New Timber Preserving Plant at Galesburg, Ill.; Chicago, Burlington & Quincy.

tank and a 100,000-gal. steel storage tank for creosote. This room was specially designed for these tanks, arched ceiling beams being used to permit the convex tank roofs to come close to the ceiling and thus avoid waste of space. Outside, close to the building, are the storage and measuring tanks. There is one 500,000-gal. steel tank for creosote storage and two 5,000-gal. steel creosote measuring tanks; also two 50,000-gal. wooden tank for zinc chloride. The outside creosote tanks have steam heating coils.

Reinforced Concrete Foundation for Tank; Galesburg Timber Preserving Plant.
Table for second foundation in form in foreground.

All tanks are set on reinforced concrete foundations. These are of two types, one of which is shown herewith by a photograph and the other by a drawing. The foundation shown in the photograph is for one of the 50,000-gal. zinc chloride tanks. The concrete columns, which are 22 in. in diameter, rest on piers and are joined at the top by 12-in. x 16-in. beams. Columns and beams are reinforced and tied together by four ¾-in. corrugated bars near the bottom of the beams. The two inner bars are made continuous through all the beams, while the two outside bars in each beam are bent downward and run to the foot of the column. The table is 6 in. thick and is reinforced with ½-in. bars spaced 6 in. on centers. At first it was intended to make the tank foundations of plain concrete. But there is considerable vibration of the tank when the liquid is being forced in it; in fact, if care is not used when first opening the valves the sudden rush of the liquid will cause heavy shocks within and to the tank. For this reason reinforcing was put in the foundations.

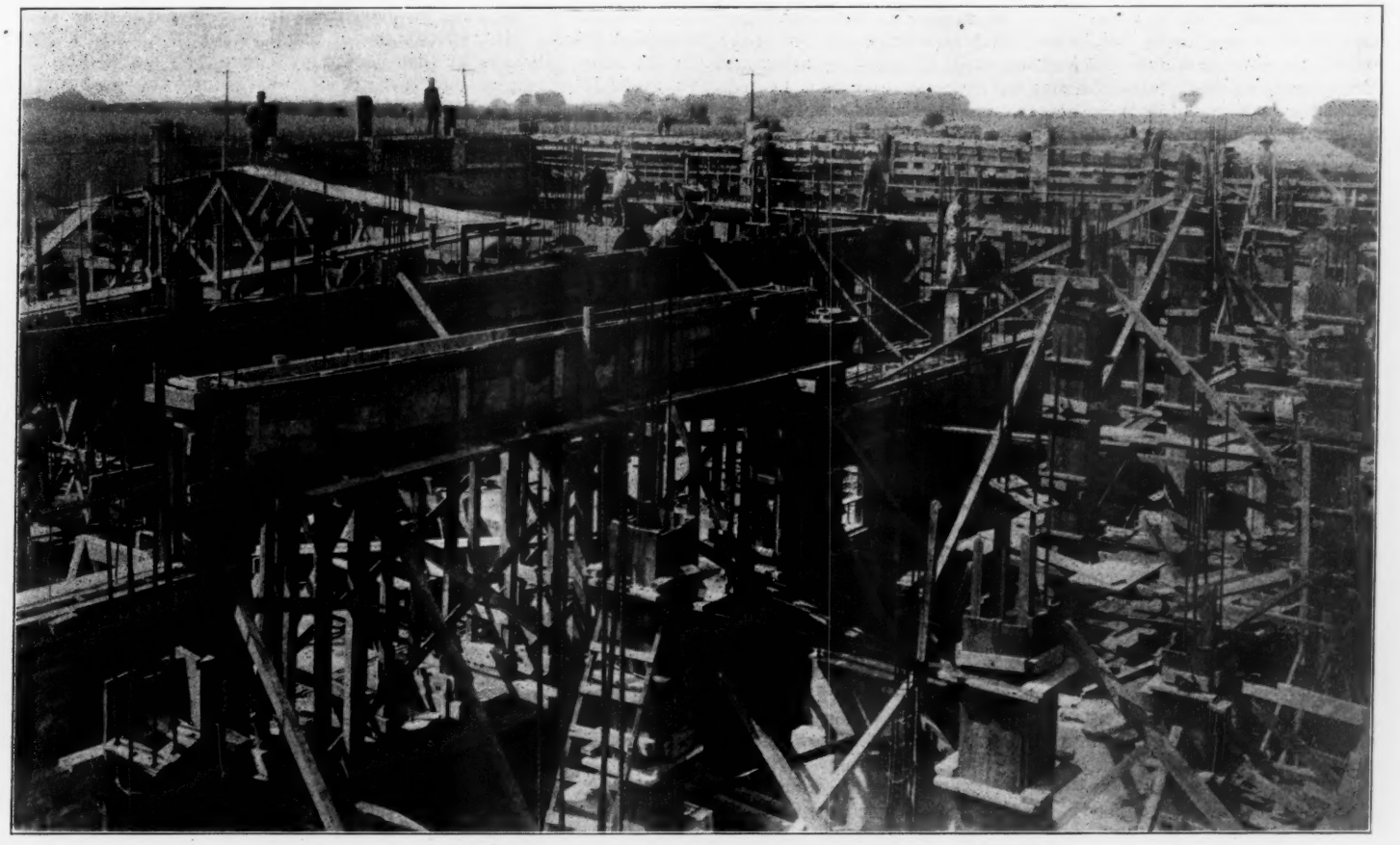
The drawing shows the foundation for the 15-ft. steel tank in the tank room. The columns are rectangular in section, those at the periphery being 18 in. x 24 in. and the others 24 in. square. All details are shown by the drawing.

There is a concrete loading platform 480 ft. long and 25 ft. wide in the yard. Narrow-gage tracks from the retort room run on top of it and there is a standard-gage track each side. The yard is piped for fire protection, with hydrants well distributed. The water for this and for the boilers is obtained from a well 1,200 ft. deep, yielding 6,000 gals. an hour. There is a steel storage tank of 100,000 gals. capacity.

Besides the four large rooms in the main building already mentioned, there is an experiment room, 16 ft. x 39 ft., fitted with a miniature tie treating plant, whose retort will hold two ties.

The preparation of the plans of the plant and its construction were in charge of W. J. Frein, Architect of the Burlington, under the supervision of T. E. Calvert, Chief Engineer. The buildings were erected by the Knickerbocker Roofing & Paving Co., Chicago. F. J. Angier, superintendent of the plant at Sheridan, has been put in charge of the new plant. The Sheridan plant is being renewed and modified to administer the Rueping process in addition to those previously used.

The English have built a railroad 36 miles long on the Island of Cyprus, which is large enough, populous enough and fertile enough to support much more than this; but this it supports ill. In the first eight months of its last fiscal year its gross earnings were $12,186 and its working expenses $31,179.



Forms for Erection of Main Building; Galesburg Timber Preserving Plant.

Interstate Commerce Report.

The following extracts are taken from the twenty-first annual report of the Interstate Commerce Commission, issued Jan. 6, which is of special interest because it covers the first year's work under the 1906 Rate Law.

Little more is attempted in this report than a general statement of the work performed by the Commission during the last year in the discharge of its official duties. A considerable part of the time has been occupied in giving administrative construction to various provisions of the law for the guidance of both shippers and carriers. To secure the best results of legislation with the least possible delay there was obvious need of a correct and uniform interpretation of the statute. Therefore, without reference to questions arising in particular cases, and to avoid unnecessary controversy, it has seemed our duty to construe the law in advance wherever it appeared obscure or ambiguous, so that the obligations of the railroads and the rights of the public might be promptly understood. This has resulted in numerous rulings explaining our view of the meaning and application of various provisions of the statute. These rulings have in practically every instance been accepted by the carriers, even in cases where their legal advisers were not entirely in accord with the opinion of the Commission.

The benefits of this course are beyond question. The Commission has endeavored to adopt a workable construction of the law in all cases, and has as a rule announced its conclusions in matters of importance only after conference and discussion with representative shippers and traffic officials. This is especially true with reference to tariff regulations. This matter is fundamental in any scheme of public regulation. There is scarcely a complaint or controversy which is not based upon the schedules of rates and charges established by the carriers. If those schedules are clear and definite in their statements, there is no excuse for disregarding them. If the rates and regulations are reasonable and plainly announced, the shipper knows his rights and the railroad official knows the obligations of his company. If the charges are claimed to be excessive or discriminatory, the question can be intelligently determined after the full hearing which the statute provides. It is believed that the efforts of the Commission in this direction have already been fruitful of good results and that they will prove of increasing value in the future.

The amended law has now been in force for upwards of 15 months, and some opinion may be expressed as to its operation and effects. The substantive provisions of the original act, forbidding the exaction of unreasonable charges and prohibiting discriminations between persons and places, were unchanged by the legislation of 1906. The main purpose of that legislation was to provide more adequate means for the enforcement of rights and duties already declared to exist. The vital principle of a right is found in the obligation to respect it. Without remedial procedure the declaratory portion of any law is little more than the statutory expression of a sentiment, but when efficient machinery for securing observance is provided the performance of definite duties and the recognition of definite rights may be expected to follow in ordinary conduct without resort to litigation. That this is true in regard to the amended act, and to an extent not generally appreciated, is confidently asserted. Just as the value of criminal laws is measured by the peace and security of society rather than the occasional conviction of offenders, so the salutary effects of the present statute are shown in the more general enjoyment of previously existing rights rather than by the number of cases in which the authority of the Commission has been invoked or the list of decisions and prosecutions which makes up the record of administration.

It is likewise true that the substantial and permanent benefits of this law are indirect and frequently unperceived, even by those who in fact profit by its observance. It means much for the present and more for the future than the principles of this law have gained greatly in general understanding and acceptance. The injustice of many practices which were once almost characteristic of railroad operations is now clearly apprehended, and an insistent public sentiment supports every effort for their suppression. By railroad managers almost without exception the amended law has been accepted in good faith, and they exhibit for the most part a sincere and earnest disposition to conform their methods to its requirements. It was not to be expected that needed reforms could be brought about with more or less difficulty and delay, but it is unquestionably the fact that great progress has been made and that further improvement is clearly assured. To a gratifying extent there has been readjustment of rates and correction of abuses by the carriers themselves. Methods and usages of one sort and another which operated to individual advantage have been voluntarily changed, and it is not too much to say that there is now a freedom from forbidden discriminations which is actual and general to a degree never before approached. As this process goes on, as special privileges disappear and favoritism ceases to be even suspected, the indirect but not less certain benefits of the law will become more and more apparent.

An incidental respect in which equality of treatment has been greatly promoted is in such matters as switching, terminal, demurrage, reconsignment, elevation and other charges making up the aggregate cost of transportation. In the past it was often within the power of a carrier to waive charges of this nature in favor of particular shippers while collecting them from business rivals. Now the law and the rules of the Commission require all charges of this description to be plainly stated in the tariffs and to be applied with the same exactness and uniformity as the transportation rate itself. This is only one of the ways in which distinct advance has been made toward placing competing shippers in each locality upon a basis of equality in the enjoyment of a public service.

It is this general and marked improvement in transportation conditions that the Commission observes with special gratification. The amended law, with its enforceable remedies, the wider recognition of its fundamental justice, the quickened sense of public obligation on the part of railroad managers, the clearer perception by shippers of all classes that any individual advantage is morally as well as legally indefensible, and the augmented influence of the Commission resulting from its increased authority have all combined materially to diminish offensive practices of every sort and to signally promote the purposes for which the law was enacted.

Under the operation of the interstate commerce act the right to initiate interstate rates rests entirely with the railroad, which may, by giving 30 days' notice, put into effect any rate or any regulation or practice affecting a rate which it sees fit. The Commission is not required to approve these rates and has no authority whatever to condemn them. It can only act upon a rate so established by the railroad in case a formal complaint is filed attacking that rate and after a full hearing. This is the express provision of the statute.

In the majority of instances, perhaps, advances may properly be made before the reasonableness of the advanced rate has been finally passed upon by this Commission; but there are also many instances where great injustice must result unless matters can be kept in statu quo while proceedings are pending to test the reasonableness of the advance. Where a rate has been maintained for a considerable time and where business interests will be seriously affected by its change it is no undue hardship to require the carrier to continue that rate in effect until the propriety of the advance can be passed upon, and to finally make the advance itself at such time as will work no unnecessary injury. Certainly there ought to be some tribunal to which shippers can appeal, with authority, if such a course seems just, to prohibit the advance or the change until the general question can be considered.

At the present time it is not very clear whether such authority anywhere exists. Certainly the Commission does not possess it. It cannot itself by any order restrain the advance, nor can it, apparently, apply to the courts for such a restraining order unless the advance works such a discrimination as is forbidden by the so-called Elkins bill, and this is not usually true of a mere increase in the rate. In several instances courts of equity have interfered to prohibit advances pending proceedings before the Commission. In these cases an injunction has been issued in favor of the complainants alone, so that at the present time the general public is paying the advanced rate, while the complainants are being charged the old rate. These injunctions were granted upon the filing of a bond—$10,000 in one case and $250,000 in the other. It is evident that the application of any such practice must result in discrimination and hardship to the general public.

We suggest that when an advance in rates or a change in any regulation or practice is attacked by complaint to this Commission, the Commission shall have the power, in its discretion, after notice to and hearing of the parties, to prohibit the taking effect of the advance or change until the matter has been finally heard and determined.

At all events Congress should definitely understand that we, under the present law, are powerless to act in reference to these advances except upon the filing of a formal complaint and after a full hearing of the case.

RAILROAD INVESTMENTS.

The joint control of the Alton Railway by the Union Pacific and the Chicago, Rock Island & Pacific Railway Company has undoubtedly eliminated competition between the Alton and the Rock Island between Chicago, St. Louis and Kansas City.

These are conspicuous illustrations of the development of the theory of "community of interest" and "harmony of management" which Mr. Harriman suggested when he demanded representation upon the Santa Fe board.

If the policy of purchasing and controlling stocks in competing lines is permitted to continue, it must mean suppression of competition.

The function of a railroad corporation should be confined to the furnishing of transportation. Railroads should not be permitted to invest generally in the stocks, bonds and securities of other railroad and steamship companies, except connecting lines, for the purpose of forming through routes of transportation, in-

cluding branches and feeders. It is in the interest of the public to facilitate the consolidation of connecting lines. The credit of a railroad company is founded upon the resources and prosperity of the country through which it runs. Its surplus funds and credit should be used for the betterment of its lines and in extensions and branches to develop the country contiguous to it. The testimony taken upon this hearing shows that about 50,000 square miles of territory in the state of Oregon surrounded by the lines of the Oregon Short Line Railroad Company, the Oregon Railroad & Navigation Company and the Southern Pacific Company are not developed, while the funds of those companies which could be used for that purpose are being invested in stocks like the New York Central and other lines having only a remote relation to the territory in which the Union Pacific system is located.

Railroad securities should be safe and conservative investments for the people. To this end the risks of the railroad should be reduced to a minimum. Every one knows that railroad securities fluctuate more or less, according to the prosperity of the times, and also by reason of the wide speculation in such securities. It therefore adds an element of hazard to a railroad's capital and credit to have its funds invested in the stocks or other companies, thereby endangering its solvency and its ability to pay reasonable dividends upon its own capital stock. It is a serious menace to the financial condition of the country to have large railroad systems fail to meet their obligations or go into the hands of receivers, and the object of legislation and administration should be to lessen the risks of railroad investments.

It is contrary to public policy as well as unlawful for railroads to acquire control of parallel and competing lines. This policy is expressed in the federal laws and in the constitutions and laws of nearly every state in the Union. We have examined the constitutions and laws of all the states, and find in about 40 of them prohibitions against consolidations of capital stock or franchises of competing railroads, or the purchase and acquisition by a railroad of competing lines. Competition between railroads as well as between other industries is the established policy of the nation. And while the acquisition of a small minority of the stock of a competing line might not decrease the competition, yet the acquisition of any considerable amount of stock, with representation on the board of directors of such railroad, unquestionably has the effect of diminishing competition and lessening to that extent its effectiveness. So long as it is the policy of the general government and of the states to maintain competition between naturally competing lines, the ownership of any stock by one railroad in a competing railroad should not be permitted, and such lines of railroad should be prohibited from having any common directors or officers.

The time has come when some reasonable regulation should be imposed upon the issuance of securities by railroads engaged in interstate commerce. We are aware that in the construction of new lines of railroad, developing new territory, it has been necessary in many instances to sell railroad securities at large discount, and to sell bonds with stock bonuses, and even in such cases it has many times been difficult to raise the necessary capital. Men will not invest their money and take the risk for small rates of interest.

But this principle does not apply to old fashioned railroad systems having good credit. Such railroads should be prevented from inflating their securities for merely speculative purposes. Railroads should be encouraged to extend their systems and develop the country. It is of the utmost importance, also, that railroad securities should be safe and conservative investments for the public and should yield good and ample return for the money invested. Reasonable regulation will tend to make them safer and more secure investments, and thereby benefit not only the railroad companies but the public.

VALUATION OF RAILROAD PROPERTY.

Reference has been made in previous reports to the importance of a physical valuation of railroad properties. The considerations submitted in favor of such a valuation need not be repeated at this time. It may, however, be proper to call attention to the fact that the introduction into operating expenses of a set of depreciation accounts brings prominently into view an added necessity for an inventory of railroad property. The chief purpose of the depreciation accounts is to protect the investor against the depletion of his property by an understatement of the cost of maintenance, and to protect the public against the maintenance of unduly high rates by charging improvements to cost of transportation. These accounts, which serve so important a purpose, require for their proper and safe administration complete and accurate information relative to the value of the property to which they apply, and this information can only be secured by a formal appraisal embracing all classes of railroad property.

Yet another reason may be submitted. Before the close of the present fiscal year the Commission will be in a position to prescribe a standard form of balance sheet. The purpose of a balance sheet is to disclose the financial standing of a corporation, and this it does by placing in parallel columns a statement of assets and of liabilities. But in the case of railroad companies the Commission is unable to test the accuracy of the assets reported, and there is no feasible means of providing such a test other than by a detailed inventory of the property which the assets represent. If Congress designed, by the provision which it made for a prescribed system of accounts, that the Commission should do what lies in its power to guarantee the sound financing of railroads, the necessity for making an inventory appraisal of railroad property cannot longer be delayed.

From whatever point of view this question of valuation be regarded, whether of reasonable capitalization, of a reasonable schedule of rates, of effective administration of the depreciation accounts or of the correct interpretation of the balance sheet, one is forced to conclude that an authoritative valuation of railroad property is the next important step in the development of governmental supervision over railroad administration.

The Commission cannot emphasize too strongly the significance of the supervisory work which, upon the authority conferred by the twelfth section of the act to regulate commerce as amended, has assumed such large proportions; and believing as it does that a comprehensive, systematic and authoritative valuation of railroad property is essential for the successful development of this work, as well as for other purposes named, it does not hesitate to submit to Congress a formal recommendation for the enactment of a law under which such a valuation can be made.

HOLDING COMPANIES.

The compilation of reports has been greatly embarrassed by the fact that certain "holding companies" have questioned the authority of the Commission to require the information sought.

Two illustrations, showing the character and effect of holding companies, may be noted.

The Rock Island Company was organized apparently for the purpose of securing a centralized control over operating properties. Its interest is confined to the Rock Island system of railroads. It has, so far as its reports to stockholders reveal the facts, no equities in any other industries nor in any other railroad systems than those generally regarded as a part of the Rock Island railroad system.

The Rock Island Company was chartered in New Jersey in 1902 as a holding company. It had outstanding, outside of the treasury, on June 30, 1907, $49,047,390 of preferred stock and $89,602,402 of common stock, a total of $138,649,792. It has no debt.

The Chicago, Rock Island & Pacific Railroad Company, chartered in Iowa in 1902, is in fact a holding company intermediary between the operating companies and the Rock Island Company. Its entire outstanding stock, amounting to $145,000,000, is owned by the Rock Island Company, which the latter corporation secured in exchange for its own stock. The Chicago, Rock Island & Pacific Railroad Company, using this Rock Island Company stock in combination with two issues of collateral trust bonds, has purchased more than 93 per cent. of the stock of the Chicago, Rock Island & Pacific Railway Company, and nearly 60 per cent. (practically the entire common stock issue) of the St. Louis & San Francisco Railroad Company stock, the stocks of these two latter corporations being deposited as security for the collateral trust bonds.

It should be noted further that the Chicago, Rock Island & Pacific Railway Company owned on June 30, 1907, 48 per cent. of the stock of the Chicago & Alton Railway, which amounts to virtual control; that the St. Louis & San Francisco Railroad Company owned 82½ per cent. of the stock (excluding treasury holdings) of the Chicago & Eastern Illinois Railroad Company, and that this latter corporation owns 60 per cent. of the stock of the Evansville & Terre Haute Railroad Company.

The voting right of securities is also pertinent. Holders of the preferred stock of the Rock Island Company have the right, to the exclusion of holders of the common stock, to choose the directors of the first class, such right to be surrendered only with the consent of two-thirds of the preferred stockholders. Furthermore, the amount of preferred stock cannot be increased, except upon affirmative vote of the holders of two-thirds of the entire preferred and two-thirds of the entire common stock. It therefore appears that a majority of the preferred stock of the Rock Island Company, or say, $25,000,000 out of a total of $49,000,000 of preferred stock of that corporation, dominates the situation and controls the vast network of railroad lines comprised in the Rock Island system.

Another striking instance of consolidated control through the medium of a holding company is that of the Atlantic Coast Line Company, of Connecticut, organized in 1889 for the purpose of consolidating under one ownership a series of Southern roads along the Atlantic coast. This corporation, with a capitalization on June 30, 1906, of only $10,500,000 of stock and $13,000,000 of certificates of indebtedness, owned more than 53 per cent. of the stock of the Atlantic Coast Line Railroad Company. The significance of this holding becomes clearer when it is observed that on June 30, 1907,

the Atlantic Coast Line Railroad Company owned $30,600,000 out of $60,000,000, or 51 per cent., of the stock of the Louisville & Nashville Railroad Company, and that the latter corporation, jointly with the Southern Railway Company, owned 88 per cent. of the stock of the Chicago, Indianapolis & Louisville Railroad Company, and leased jointly with the Atlantic Coast Line Railroad Company the railroad properties of the Georgia Railroad and Banking Company. This holding company, with a comparatively small capitalization, which represents still less of actual investment, probably not more than $5,000,000, is in control of a railroad system more than 5,000 miles long, and with capital stock aggregating considerably more than $100,000,000.

It is not intended to discuss the economic justification of such holding companies, if, indeed, they can be justified from that point of view. The significant fact for the consideration of Congress is that companies of this class deny the jurisdiction of Federal supervision under the law, a contention which, if admitted and carried to its logical result, would exclude many important financial questions which affect public interests from the supervisory control of the Commission. It is the purpose of the Commission to bring this question to judicial determination, but in order to arrive speedily at some practical conclusion, to the end that the work undertaken be not further embarrassed, it is respectfully submitted that the act to regulate commerce be amended so as to make clear the responsibilities and the rights of the Commission as regards holding companies.

Massachusetts Railroad Commissioners' Report.

The state railroad commissioners of Massachusetts, W. P. Hall, G. W. Bishop and Clinton White, have issued the thirty-ninth annual report of the Board. The first part of the report is taken up with the usual statistics and with the report of the Bridge Engineer. Acting under the law passed in 1906 dividing railroads into three classes; "railroad corporations," "street railway companies" and "electric railroads," the board has issued one certificate of public convenience and necessity to an electric (interurban) railroad, has rejected two and has two others under consideration. The board has again investigated the locomotive smoke nuisance but finds nothing new to say. The principal difficulty is in unskilful firing. The board believes that before long electric motive power will have to be used in order properly to abate the smoke nuisance, and recommends that the whole question of electric propulsion be studied.

Eleven grade crossings have been done away with during the past year. Since 1890, when the state began to aid the towns in this work, over $29,000,000 has been expended; nearly 18 millions by the railroads, nearly eight millions by the state and the rest by the cities and towns.

Two years ago the board recommended a law providing for compulsory block signaling and the report gives a brief statement of the number of miles of track on each road now worked under the block system, but it does not appear that any mandatory orders have been issued. The board has formally approved the use of automatic block signals of different types now in operation on the three principal roads of the state, but does not appear to have approved manual signals anywhere except on the New York, New Haven & Hartford. The Boston & Maine intends to expend $370,000 on automatic signals in 1908 finishing the equipment of all its double-track lines in Massachusetts. The Boston & Albany proposes to equip 23 miles of track this year. The New York, New Haven & Hartford has no new work laid out for this year on its lines in Massachusetts. Speaking of block signaling generally, the board expresses satisfaction with the progress of the work and with the attitude of the officers of the railroads.

Over 25 pages of the report are devoted to the Boston & Albany, the legislature having directed the board to make a special investigation of that road on account of the poor service afforded. The improvements made during the past year are set forth in considerable detail and the commissioners seem to think that the managing officers are now doing their best to put the road in condition to give good service.

Concerning the ventilation of street cars, which was discussed in the last preceding report, the commission says:

> The Board has recently changed its requirement with reference to the point of outside temperature at and below which companies are called upon to heat street cars, making that point 40 instead of 50 degrees above zero, the temperature to be then maintained to have a range that shall not be lower than 40, nor higher than 60 degrees. In making this radical change and certain other changes, the Board has had in view a rule that companies will find it possible to obey, and that the district police can enforce under the statute which makes them responsible for its enforcement.
>
> It is notorious that opinions differ as to what the temperature of a room in a private house ought to be, and that the same person entertains different opinions at different times, according to condition of health or circulation of blood. Obviously, then, an attempt to always satisfy every occupant of a street car with the atmospheric conditions must be futile. Even if passengers were of the same mind, it is impracticable to constantly maintain air of a given quality and the temperature at a specific point in a car that is one moment nearly empty and the next crowded to the limit; now stationary, then in motion; with doors continually opening and shutting, and with an outside temperature varying between zero and 40 degrees above.
>
> Companies are not, however, relieved from the obligation to keep the air in cars reasonably warm and pure on account of the difficulties in the way of doing this to the satisfaction of every critic. In fulfilling their obligations both management and employee must expect to deal with the old and young, with the robust and feeble, with those who thrive on draughts of cold air and with those to whom such draughts are fatal; with those who are dyspeptic and nervously unsound, as well as with the sane and cheerful.
>
> The day of horse cars, with straw on the floor to keep the feet warm, and with no ventilation except that afforded through the doors, is within easy recollection. While to-day the electric heater exemplifies radical progress in heating, the ventilator commonly in use is about as crude as any device could be. Present discomfort is due fully as much to the failure to properly use means at hand for keeping the air pure and warm as to imperfection in apparatus. There is no reason why, for example, a movable ventilating window should be kept entirely open or entirely shut, or in any one position throughout a long journey in total disregard of the temperature outside and of the changing conditions inside the car.
>
> It should be a part of the regular duty of those in charge of cars to regulate both heating and ventilating apparatus from time to time to meet varying needs. Admirable work of this kind is now done by individual conductors, and there is no reason why their success in caring for the public should not become a general feature of the service. Co-operation, too, between passengers and employees is of great benefit to both, and the privilege of making suggestions ought not to be monopolized by the chronic complainant.
>
> The Board must ask that companies adopt prompt measures for a larger experimental use of the more improved methods of ventilation, and meanwhile enforce rules for adjusting all devices in use to existing conditions.

Possible Peace in Passenger Fares.

In South Carolina, which state has not followed its neighbors in taking radical action concerning railroad rates, the Southern Railway has announced a voluntary reduction in passenger fares. President W. W. Finley, in announcing the new rates, proposes that they shall be kept in effect for one year so as to give the scheme a fair trial. In detail the proposition, as sent by Mr. Finley to the Governor of the state, is as follows:

First—A flat rate of 2½ cents a mile for interstate passenger travel, with an extra charge of 15 cents against persons boarding a train without a ticket except at stations where there are no agents, provided that no charge shall be less than 10 cents, and in the event that a charge at the said rate of 2½ cents a mile shall aggregate a sum between two multiples of five, such charge may be made that multiple of five to which it is nearest.

Second—Two thousand mile books, intrastate, interchangeable with such of the solvent roads of the state as will consent, at 2 cents a mile, good for heads of firms and employees not exceeding a total number of five, the names to be furnished at the time of the purchase of mileage book and entered thereon.

Third—One thousand mile books, intrastate and interchangeable with such of the solvent roads of the state as will consent, limited to one individual at 2 cents a mile and good only in the hands of the purchaser, the name of the purchaser to be furnished at the time of the sale of the book and entered thereon.

Fourth—Five hundred mile books at 2¼ cents a mile, good for heads of families and dependent members thereof, intrastate and non-interchangeable, the names of the families to be furnished at the time of purchase and entered thereon.

All of such mileage books to be limited to one year from date of purchase and redeemable, charging for the part used at 2½ cents a mile.

It is reported in Atlanta that the State Railroad Commission of Georgia, acting in line with the recent propositions made by the Southern Railway, will soon order the establishment of a uniform rate of 2½ cents a mile for passenger fares throughout the state of Georgia, the change to go into effect April 1. If this should be done there are a few lines on which the present rates would be increased. On the Atlanta & West Point and the Western & Atlantic the present rate is 2 cents.

It is reported that the Virginia Commission also will issue an order in consonance with President Finley's offer.

Opening of New York Subways.

The subway under the East river from the Battery, in Manhattan, New York City, to the Borough Hall, in Brooklyn, was put in use for regular traffic on Thursday morning, January 9. This subway is operated by the Interborough Rapid Transit Company, the same as the Manhattan subways, and trains are run through from the northern termini in the borough of the Bronx to the Brooklyn Borough Hall.

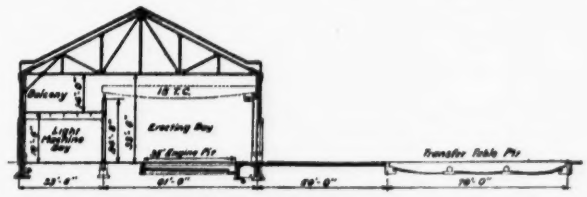
The tunnel of the Hudson & Manhattan Railroad, beneath the Hudson river, from Hoboken, N. J., to Christopher street, New York City, which will be open for business within a few weeks, has been so far completed that a special train, carrying officers and guests, was run through on January 4. The trip was made in about seven minutes.

Arrangement of Railroad Shops.*

Railroad repair shops cost money, both to build and to operate. Just at this time it may be of interest to approach the subject of their design, arrangement and equipment from a financial standpoint. There is hardly a better field for demonstrating that "engineering is the science of making a dollar go the farthest" than the art of designing and building railroad repair shops, and, as nearly all work of this character must start with an "authority for expenditure," or perhaps an "appropriation," it will be instructive to inquire just how great an investment in repair shops will ordinarily be justified.

The original cost of an average modern locomotive may vary from $14,000 to $17,000. The actual expense for labor and material to mainfain this locomotive in first class condition will range from $1,500 to $3,000 per year, each road, of course, having its own individual conditions that influence this cost, and which make it impossible to establish an absolutely definite figure. For our present purposes, however, it may be said that a locomotive costing $15,000 will involve a maintenance cost of about $2,250 per annum, and this expenditure should go far toward overcoming the natural depreciation of and wear on the equipment, and thus keep the locomotive in first class running order.

The original investment in a complete new locomotive repair shop, fully equipped to efficiently make these repairs, will depend on the location, the size, the design, the selection of the equipment and the cost of labor and material entering into the buildings. These factors are so variable that it is impossible to determine an average that can be regarded as an exact standard. Even an approximate estimate for any given case can only be obtained after a detailed study has been made of the conditions surrounding the particular problem in hand. The following figures



Cross Section of Oelwein Main Shop—Chicago Great Western.

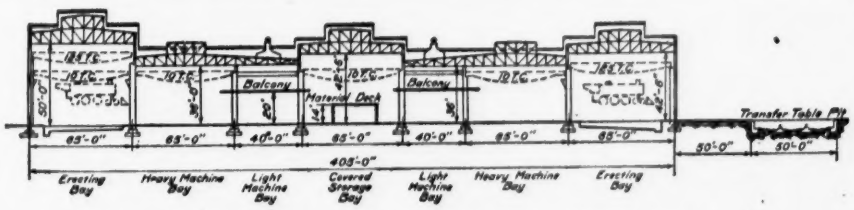


Fig. 1—Cross-Section of Main Shop Now Under Consideration.

must, therefore, be used with judgment, or they may be misleading. These figures have been taken from the records of the actual cost of a number of repair shops with the design and construction of which the writer has been connected. The fact that there is such a wide variation emphasizes the danger of deriving a general law from any particular experience, or even of drawing a conclusion for a particular case from a general experience.

The figures, however, should be of assistance in determining the limits outside of which it will ordinarily be unwise to go. To spend less money than indicated in the "low" estimate might be the result of a fortunate set of circumstances contributing to economy, but every precaution should be taken to insure that the saving accomplished is not at the expense of a false economy. To spend more money than indicated by the "high" estimate may be desirable, or even necessary in certain cases, but ordinarily the higher figures are sufficient to cover all repair shop needs, unless it is the intention of those in charge of the work to erect a monument.

The writer has purposely approached this subject of cost with considerable caution, and it is only because the literature of shop building is so meagre of actual cost data that the risk has been taken of having the figures misunderstood, and therefore the information misapplied.

Our records show that locomotive repair shops which are laid out on a basis of the number of pits required equal to 6 per cent. of the number of locomotives served can be built and equipped complete for an expenditure ranging between $50,000 and $65,000 per pit. If one pit will serve 16⅔ engines per year, the cost of repair facilities will fall some place between the limits of from $3,000 to $4,000 per locomotive. An investment amounting to the lower limit is absolutely necessary if the engines are to be kept on the road. Just how much more than the lower limit should be spent in order to secure the minimum cost of locomotive maintenance, including all the items of not only actual repair expenses, labor and material, but also interest, depreciation, insurance and taxes upon the plant provided, is a question that should have the most careful consideration.

The following analysis of the total cost will serve to indicate the relative importance of the decisions that must be reached in order to give each dollar expended a maximum earning capacity. The sum total of the "low" and of the "high" figures shown will result in grand totals which will show a wider range than the 33⅓ per cent. variation indicated by the unit figures of $3,000 to $4,000 per locomotive, but as it is improbable that any shop would be built using either the lowest or the highest estimate for every one of its parts it will be found that only in exceptional cases will the actual total cost fall outside of the limits first given.

TABLE OF COST LIMITS FOR LOCOMOTIVE REPAIR SHOPS,
On the Basis of 25 Erecting Pits.

	Limits of cost per pit		Approx. Proportion of total cost
Divisions: Shop Yards.	Low.	High.	per cent.
Tracks, crane runways, transfer or turntables	$1,400	$3,000	4
Water and sewer system	1,000	1,800	2
Piping and wiring tunnels and tunnel piping	500	1,000	1
Buildings.			
Machine and erecting shop	8,000	12,000	17
Boiler and tank shop	3,000	5,000	7
Forge shop	1,500	2,400	4
Storehouse and offices	1,000	2,500	3
Locomotive carpenter shop	500	1,000	1
Power house	1,200	2,400	3
Oil house and equipment	400	600	1
Misc. bldgs.: scrap bins, material sheds, &c.	500	1,000	1
General Equipment for all Departments.			
Power-house equipment	5,000	8,000	11
Traveling cranes	1,500	3,000	4
Tool equipment	10,000	15,000	22
Heating system	1,200	2,500	3
Power and lighting systems*	1,500	4,500	5
Plumbing and lockers	300	1,000	1
Air, water, steam and oil piping in buildings	600	1,200	2
Incidentals, organization and engineering	2,000	7,000	8
			100

*Including yard wiring and lighting.

NOTE.—These figures do not include items for real estate and preparation of the shop site, which cost necessarily varies between wide limits. The foundry building and equipment are not included in these figures.

The history of "modern" locomotive repair shops may be considered as beginning with the use of what has been called "the electric drive." The use of the electric motor makes possible (a) the arrangement of departments independent of the line shaft requirements; (b) the use of electric cranes, and (c) the construction of all power producing equipment in one central power plant from which may be distributed heat, water, compressed air, light and power. One of the first shops to make use of the electric motor for both individual machines and groups of tools, as well as the electric crane and the central power plant, was the Oelwein, Iowa, shops of the Chicago Great Western, which were put in commission in 1900. Since that date there have been over 70 shops either built entirely new or modernized from previously existing plants. It is safe to say that more than $80,000,000 has been expended upon railroad repair shops and their equipment within the last 10 years.

The advance that has been made in the art during this period can best be illustrated by a comparison of the cross-section of the Oelwein machine and erecting shop and the cross-section of a shop for a similar purpose which is now under consideration, as shown by Fig. 1. The Oelwein erecting shop was equipped with one 80-ton crane and one 15-ton crane, both upon the same runway over the erecting pits. The second and more recent example has one 120-ton crane operating over the erecting pits on a runway above the two 10-ton messenger cranes, while the machine shop is supplied with two 10-ton cranes over the heavy tools, and an additional crane is provided over the covered yard.

It is needless to say that the more elaborate equipment of the latest development in repair shops cost more than the more modest shops which first adopted the electric system, but at the same time locomotive equipment has been gradually increasing in size and cost in such a way as to make these more extensive repair shop facilities an absolute necessity. Care must be exercised, however, to insure that the repair facilities provided are not greater than the needs of the equipment to be served, which brings us at once to the question of the size of the shops.

Some of the first shops designed to use a central electric power plant were handicapped by the use of the 220-volt direct current electric system, which made it desirable to limit the radius of distribution to about 1,000 ft. from the generating plant. The development of the induction motor and the alternating current system soon removed this limitation, but as it was still necessary to use the direct-current motor to obtain satisfactory electric speed control on many of the independently motor-driven tools, a mixed electric system was adopted by many shops. It is still the practice in a number of recent installations to provide both direct and alternating current throughout the shop—using direct current for the

*A paper presented at the January meeting of the Canadian Railway Club by Geo. A. Damon, Managing Engineer, The Arnold Co., Chicago.

cranes, variable speed motors, and perhaps the mercury vapor lamps, and alternating current for the constant speed motors, incandescent lights, and the yard lighting systems. The recent improvements in mechanical speed-changing devices, the development of the alternating current crane, and the reduction in cost of the induction motor are creating a decided tendency toward the elimination of the direct current system. By these improvements it is possible to distribute power from a central plant over a larger area and also remove the old limitations of the amount of ground covered by the shop plant.

The size of a locomotive repair shop will depend primarily upon the number of locomotives to be repaired each year, and the number of days each locomotive under repair must occupy an erecting shop pit. To the pits required for "heavy" repairs must be added a number of pits for "light" repairs, for emergency work and for future growth. The ratio of the number of pits to the number of locomotives will vary with the assumptions as follows:

Pits Required in Erecting Shop.

Let A = number of locomotives served by shop.
B = Percentage of locomotives to undergo "heavy" repairs each year.
C = average number days each locomotive occupies an erecting shop pit.
D = Number of working days each year.
P = number of pits required for "heavy" repairs.
P′ = number of pits required for "light" repairs.
P″ = Total number of pits required.

Then

$$P = \frac{A \times B \times C}{D}, \text{ and}$$

$$P'' = P' + P.$$

The effect of the different assumptions as to the percentage of the total number of locomotives to be repaired each year and the length of time on a pit are shown by the following table, which was prepared for a shop serving 400 locomotives at present, with a probable increase to 500 within the next five years.

			Working	Pits			Per cent.	
No. of locos.	Per cent. repaired.	Days in shop.	days in year.	Heavy repairs.	Light repairs.	Total.	P′	P″
A	B	C	D	P	P′	P″	P	A
500	80	20	288	28	7	35	25	7
500	70	17	288	21	9	30	43	6
500	60	14	288	15	10	25	66	5

From this table it will be seen that the number of pits may vary from 5 per cent. to 7 per cent. of the total number of locomotives, which variation corresponds with actual practice. Individual conditions will govern the assumptions for each road, and there are, fortunately, a number of other methods of checking these calculations.

The size of the machine shop space per pit depends largely upon the methods adopted for operating the shop. The work on the pit can be crowded, and the erecting output under normal conditions can be doubled during rush periods, but the output of the machine tools cannot be increased in the same ratio. The tendency at present is to favor the amount of floor space allowed for machine tools. On the other hand, the use of high-speed tools is rapidly increasing the output of each machine, and this development is contributing to the output efficiency of each foot of machine tool space. The space per pit for machine tools varies from 1,500 to 2,500 sq. ft. This result is often largely influenced by the demands made upon this space for manufacturing new work, or for supplying repair parts to other shops.

An average rule for the size of the boiler shop is to allow one-third as much space for this department as is allotted to the machine and erecting shop, but this rule is affected by the character of boiler repairs to be made. The kind of coal, the conditions of the water supply, and whether or not new boilers are to be constructed must be known before a final decision can be reached.

The blacksmith shop is ordinarily one-third the size of the machine and erecting shop, but local conditions must again be carefully considered before reaching conclusions. The safest way for all shops is to canvass the requirements for output and the capacity and floor space required of each machine, and then design the shop to fit the machines, rather than crowd or spread out the machines into a space the size of which has been too hurriedly determined.

The preliminary considerations which must have attention before the problems of relative arrangement of the buildings can be approached involve so much of the personal equation that only tendencies of recent practice can be noted, and no hard and fast rules can be established. It is not the province of this paper to discuss the advantages and disadvantages of the various points which must be thoroughly canvassed in order to reach consistent preliminary conclusions, as these subjects have been already covered by special books and technical papers, which are available to those who are interested enough in these subjects to study them in detail. To indicate briefly the problems which must be considered and decided upon by the shop designer early in his work on any particular layout will, however, be of value.

For instance the question of "transverse shop versus longitudinal shop" for the erecting bay must be settled before much progress can be made. The tendency appears to be in favor of the transverse shop, but the writer must admit that his own personal equation enters into this conclusion.

Whether or not the boiler shop shall be under the same roof with the machine and erecting shop is a question that is usually settled by the experience and preferences of those who are to operate the shop.

The use of a transfer table or a turntable as a means of getting locomotives into the shop is a subject upon which volumes have been and can be written, but this question is usually decided in favor of the desires of the operating official who is to have charge of the shop after it is completed.

The use of yard cranes, telphers or locomotive cranes for handling materials outside of the buildings is being given more careful attention than formerly, with the result that these auxiliary transportation systems are having a marked influence upon the arrangement of shops. There is a tendency to cover a portion of the yard with a crane, and locate the lye vats and tire furnaces in this covered yard.

The location of the storehouse and the oil house will depend upon their individual use, whether it is the intention for them to serve the entire system or not.

Fireproof concrete construction is having an effect upon bringing the storehouse closer to the various departments to be supplied, the tendency apparently being to locate the storehouse contiguous to the machine and erecting shop, as was originally done at Oelwein.

Whether to locate the car repair department contiguous to the locomotive repair department is a question of policy for the management to decide, and the answer depends largely upon local conditions of operation and organization. The location of the car repair tracks, the desirability of having the common power house near the planing mill to burn refuse, and the location of the forge shop convenient to both departments has a marked influence on the general arrangement of the shops.

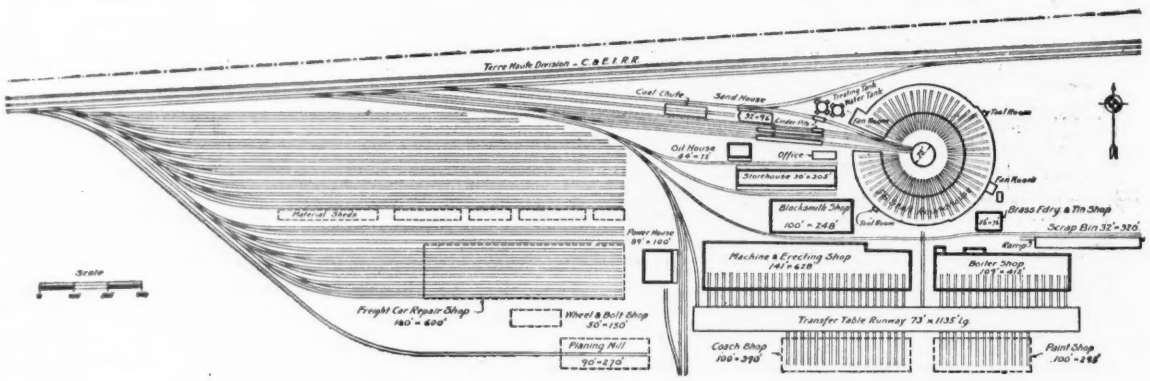


Fig. 2—Oaklawn, Ill., Shops, C. & E. I. Ry. Plan No. 2.

The location of the shop itself, as influenced by traffic conditions of the system, and the selection of the shop site after the general location has been decided, are questions in the solution of which serious mistakes have been made. Recent decisions seem to indicate a tendency to locate shops as near as possible to favorable labor markets, instead of in smaller towns, or at some inconvenient distance from the larger cities.

Certain fundamental principles should be recognized before attempting a railroad shop arrangement, and as far as possible the arrangement should be worked over until it satisfies these requirements, always recognizing exceptions due to individual conditions.

(1) Liberal space (say 100 per cent.) should be allowed for the extension of each department.

(2) The storehouse (with administrative offices in one of the upper floors) should be central, convenient to all departments and easy of access on two tracks from the main line service track.

(3) The forge shop should be convenient to both the locomotive and car repair departments.

(4) The power house should be central and near the planing mill and repair tracks in order to burn refuse.

(5) Yard cranes should be arranged to serve between the storehouse platforms and all departments.

(6) The roundhouse should be very near the shop, or located

far enough away to justify a separate machine shop for light repairs.

(7) Tracks, cranes, telphers and storage spaces should be arranged to insure the movement of materials with the greatest economy of time and labor.

(8) Some consideration should be given to the appearance of the shops and accessory storage facilities, lumber yards, etc., from the main line.

(9) The advantages of a short tunnel of ample cross-section for the use of the various steam, air and water piping systems should not be forgotten.

(10) The possibilities of the adoption of longer and heavier engines should be considered, and some provision made for present or future repair facilities for these larger engines.

(11) The cost of the shops should be consistent with not only the actual necessities, but in proportion to the refinements which the road can afford. All expenditures over and above those required for actual needs should be capitalized and made to show a satisfactory return on the investment.

Actual examples of shop arrangements can be studied to advantage; in fact, a designer of a new shop should make himself conversant with existing plants, and thus make every effort to improve present practice. Advances in any art are usually made step by step, and progress in the right direction can be made with much more certainty if there is a familiarity with the ground already covered by others.

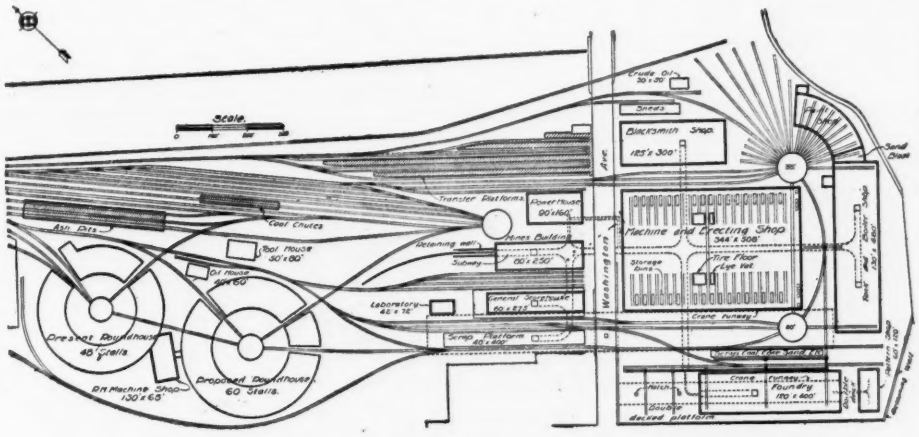


Fig. 3—Proposed Arrangement, Superseded by Layout in Fig. 4.

In this arrangement the boiler and tank shop are separated from the machine and erecting shop, and two turntables have been located to facilitate the transfer of boilers and other material from one department to another. The disadvantage of the open pits will be overcome by extending the decking of the turntable over the entire pit.

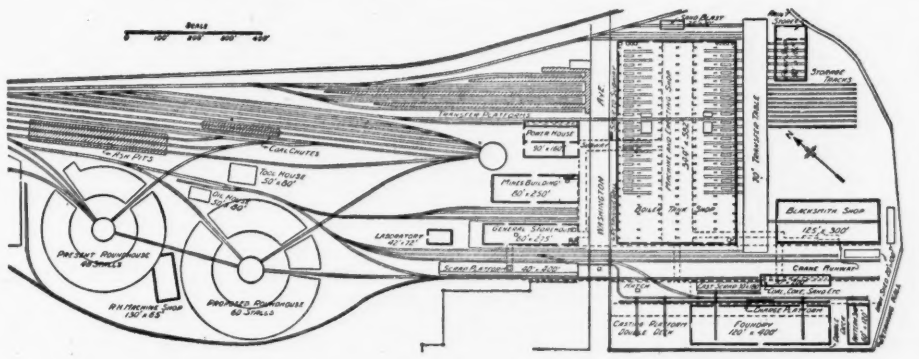


Fig. 4—General Arrangement of New Plant Now Under Construction.

In this arrangement the machine and erecting shop is served by means of a transfer table extending along one side of the shop. The boiler and tank shop is located in the extension of the main shop, it being the intention to maintain the same sections of the building throughout.

The shop arrangements described in this paper are examples taken from recent practice. None of the plans are advanced as ideal, but each one is the result of at least 20 preliminary studies, and the reasons for their selection may be of interest. In two cases the shops are not yet built, and therefore, their location cannot be disclosed.

The Ivorydale Shops of the Cincinnati, Hamilton & Dayton (*Railroad Gazette*, Sept. 21, 1906).—These shops were designed to provide facilities for the storage and care of locomotives lying over at Cincinnati between trips, and also for the necessary light running repairs upon engines running in and out of this division point. This shop is, therefore, an example of a terminal locomotive repair plant to take care of light repairs only as an auxiliary to the main repairs shop where all heavy repairs are made. The unique feature of this arrangement is the longitudinal engine house, sometimes called a "square roundhouse." This engine house is served by the same transfer table that serves the erecting shop, the two buildings being directly opposite one another across the transfer table pit. The yard tracks form a "Y," thus obviating the necessity of a turntable. Incoming engines pass onto the transfer table over one of two ash pits. There is one outgoing track. Engines can take coal and water either on the way in or out. The engine house is built of reinforced concrete, and is designed for simply the care and storage of locomotives, no drop pit being provided on the engine house side of the transfer table. The machine and erecting shop has two drop pits in a separate section devoted to light repairs, while the erecting shop proper has a drop table to unwheel engines undergoing more extensive overhauling. One track without a pit is reserved for boiler repairs, which has sufficient space to work on two boilers at one time. This arrangement makes the most economical use of the space available. It would have been impossible to have introduced the usual turntable plan with a round engine house on the property.

The Oaklawn Shops of the Chicago & Eastern Illinois (*Fig. 2*).—The remarkable thing about this plan is that in 1904 the first machine and erecting shop was built with 14 pits, and the provision made for doubling the shop was considered to be ample for years to come. In 1907, however, the shop was doubled, a fact which emphasizes the necessity of allowing ample room for growth.

In this plant the locomotive department may be said to have been grouped around the engine house, from which a shop track running between the machine shop and the boiler shop leads directly onto the transfer table, thus providing a convenient means of transportation to and from all departments. The coach shop and the paint shop have not yet been constructed, but eventually the transfer table will also serve these two buildings of the car department. The boiler shop is separate from the machine and erecting shop, and is served by the same transfer table. The blacksmith shop is convenient to the car repair tracks, as well as to the roundhouse and machine shop. The storehouse is central and handy to the main line. The power house is located between the two departments, and serves the locomotive shop through a pipe tunnel that connects all departments.

Too little space was originally allowed in the machine shop for machine tools, but this defect has been remedied to a certain extent in the recent additions. The general layout has proven so satisfactory in actual use that recently the management has had under consideration the reproduction of the entire plant at another point on the system.

In the main shop of this plant the larger individual motor-driven tools are located in the erecting bay, that is made extra wide for this purpose. The disadvantage of this arrangement is the necessity of increasing the span of the traveling cranes and thereby adding to their cost.

The Battle Creek Shops of the Grand Trunk.—The distinguishing feature of this arrangement is the efficient use of the yard crane idea, extending over the storehouse tracks and part of the storehouse platforms. This crane serves all of the ends of the bays of the machine and erecting shop; the foundry, forge shop and frog shop, and eventually can be extended over the car repair tracks. The "midway" space under the crane, which will be used partly for storage of materials, is provided with a system of industrial tracks, which are a part of a network extending throughout the entire plant. The boiler and tank shop in this arrangement are located at one end of the machine and erecting shop, but these departments are at right-angles to one another, so as not to interfere with the entire plant being doubled at some future date. Ample openings are left in the wall between the boiler and the erecting shops, so that a boiler can be conveniently passed from one department to another.

The 100 per cent. extension to the main shop will be accomplished by practically duplicating the present shop, leaving a common machine shop twice the size of the existing one between two parallel erecting shops. This arrangement will eventually provide for 50 erecting pits, and all departments can be extended to meet this maximum requirement. For the present the locomotive shop will be served by two tracks, but when extensions are made two turntables can be installed.

The Beech Grove Shops of the Big Four (*Railroad Gazette*, Nov. 29, 1907).—In this layout even more extensive use has been made of the idea of a storage yard served by a high-speed overhead crane. The midway may be said to be the main avenue of travel between all departments, and the space between the buildings can be compared to side or cross streets. This crane serves practically every building except the tank shop, the wheel shop and the freight

car repair shop, but all of these shops can be reached easily by industrial tracks.

The second feature of importance in this arrangement is the turntable serving the boiler shop, the tank shop, and the main shop of the locomotive department. Tracks have been provided into each of these buildings independent of this turntable, but for intercommunication or the transfer of parts from one department to another this turntable will be in constant demand. This turntable arrangement was adopted after the most careful consideration of an alternative plan having a transfer table along each side of the main shop, with the boiler shop on the opposite side of one transfer table, and the tank shop on the opposite side of the other table.

On one side of the yard crane nearly all the buildings extend away from the runway, thus allowing for future extension, while on the other side of the crane the buildings are arranged with their greater length parallel to the main line of travel. The freight car repair department is located along the main line tracks and convenient to the classification yards.

The Springfield (Mo.) Shops of the Frisco System.—In this arrangement the yard crane is a prominent feature, and the midway and cross street idea has been developed still further, as all buildings are at right angles to this main avenue of interdepartment travel.

The striking feature of the Frisco shop arrangement, however, is the use of the transfer table serving one side of the erecting shop only. The erecting bay next to the transfer table is single-decked, i.e., the heavy crane used for unwheeling locomotives is not placed on an upper runway, so that it will be impossible to lift one locomotive over another in this shop, and reliance must be placed in the transfer table to put the locomotives on their pits. Eventually, however, when the shop is doubled, the future erecting bay on the other side of the shop will be double-decked, and the locomotives will be delivered to their respective pits on this side of the shop by an overhead 120-ton crane, instead of by a transfer table. When the shop is extended to its full capacity, no doubt the transfer table side of the shop will be devoted largely to light repairs, and the double-decked crane-served side will take care of the heavier repairs.

The storehouse is at one end of the transfer table and near the center of the yard crane runway, so that material can be conveniently collected from or delivered to any building on the ground. The power house is located exactly in the center of the site. Every department can be increased at least 100 per cent. without unduly extending the lines of travel for men and material.

Shops Under Construction.—The arrangements indicated in Figs. 3 and 4 are good examples of shops located on a congested site, which makes it impossible to secure an efficient layout of buildings, or make any liberal allowances for future extension. The advantage of locating the shop plant near the center of the city, however, is thought to offset the disadvantage of having the shop site cut in two by a city street. Fortunately the ground is high, and the drainage is good, making possible a subway under the street, and connecting all departments. This feature adds much to the convenient handling of materials.

The yard crane is again the determining feature of the arrangement, serving nearly all departments, and arranged to take or deliver material from and to the subway, and also the street, which fortunately is on a grade, so that it can be bridged.

The location of the foundry was determined by the fact that this department was the only one which could be placed along the retaining wall which incloses part of the site. The heavy cranes in the erecting shop and the steam hammers in the forge shop make it desirable to locate these latter departments on solid ground.

The transfer platforms, one roundhouse, and the accessory ash pits and coal chutes were in place at the time the new shop arrangement was taken up, but even with these handicaps, a fairly satisfactory arrangement of buildings has been worked out.

Shops Under Consideration.—The layout of shops in Fig. 5 is now under consideration and provides for a complete locomotive repair shop combined with a proposed terminal car repair plant. The main car department is located elsewhere.

This plan shows a crane-served covered yard extending through the center of the main shop. This yard is not to be heated, and besides furnishing storage facilities for material, it will provide a convenient location for fan rooms, toilet rooms, locker and wash rooms, which often occupy valuable room inside the shop.

The outside storage yard is served by a locomotive crane instead of an overhead crane, and this same locomotive crane can be used at all other points in the yard where it can be worked to advantage.

The transfer table serves one side of the machine and erecting shop, as in several of the other plans, two cross tracks being provided to transfer engines into and out of the erecting bay on the further side.

As the main shop becomes crowded, it is possible to erect a separate boiler and tank shop along the transfer table as shown, but for the present all locomotive repair departments will be under one roof.

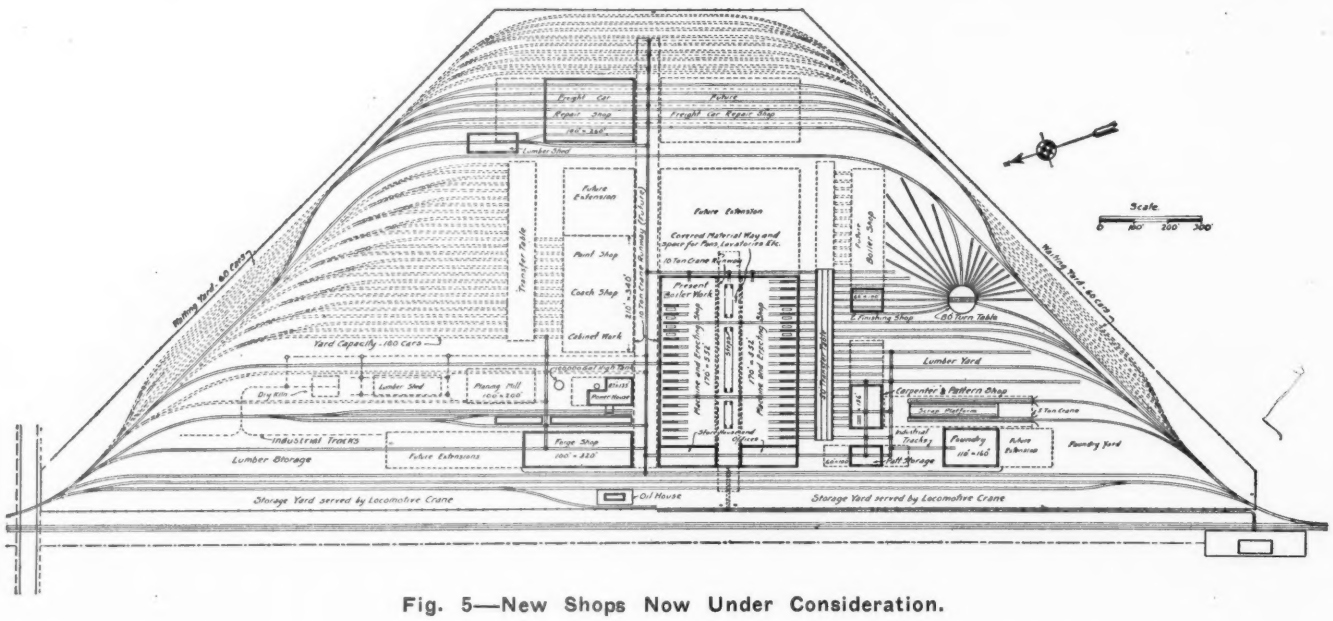


Fig. 5—New Shops Now Under Consideration.

The usual precautions have been taken to locate the blacksmith shop and the power house convenient to all departments.

The cross-section of the main shop (see Fig. 1) shows the covered yard between the two shops as well as the transfer table serving one side of the building.

Will the results to be expected with new shops justify the investment? This is a question very often asked, particularly in view of the fact that apparently some of the new shops are not showing any better economy as far as actual cost of locomotive maintenance is concerned than is obtained with comparatively older and poorly equipped shops. As a matter of fact, there is no reason why a new shop handicapped with an undeveloped organization and a lack of an efficient system, should do any better work, or even as good, as an old shop with a harmonious corps of workers equipped with a full complement of jigs, templets and methods of operation.

The logical developments in cutting down the cost of engine repairs upon any road would appear to be (a) make the best use of the repair equipment at hand by perfecting shop kinks and systems for handling the work adapted to the outfit available; (b) to wear out the old tool equipment in the old shop as far as possible, so that when the building of the new shop cannot be postponed longer there will be little, if any temptation to economize by using the old tools; and (c) with the coming of the new shop, old methods of operation should be improved to fit the changed conditions and new systems developed and adopted. A new shop should not be considered complete until every man, tool, accessory and system is doing its most effective work. Under these conditions the new shops will show ample results to justify the in-

opment of the induction motor and the alternating current system

vestment.

W. A. Gardner to the Traveling Engineers.*

Having accepted office, you have doubled your responsibilities. Heretofore, you have served two interests—your family and your master mechanic; now you have four interests to consider—your family, the public, your subordinates and the shareholders that own your company. * * * A higher standard of zeal and accuracy maintains in railroad service than elsewhere. In all ordinary business, an error or over-sight is speedily corrected, generally without personal injury or financial loss, but in engine or train service an error or over-sight is quite likely to result in fatalities, and there is no business on earth where the opportunities for mistakes are so numerous. Happily, the employees are so instinctively alert and have been so trained and drilled until it is a part of their every day life to be ready for emergencies all the time, that comparatively few mishaps occur. So while we read of medals being awarded to people for devotion to duty in their particular line, we must be content with the approval of our immediate associates and our own conscience until such time as some impartial historian analyzes railroad service without prejudice and records the fact that railroad employees, as a class, embrace a very large number of the highest types of manhood, conspicuous equally for efficiency and modesty.

* * * Very few men are fit to govern unless they have been governed, and it is very easy on a railroad to detect those who are trying to boss without ever having been bossed themselves. * * * I take it for granted that a traveling engineer, before he accepts promotion, has agreed with himself that he has come to a parting of the ways—a peaceable and self-respecting parting, however. Of course, the old man you fired for will look askance at your suggestions as to how he might do better work. Those who fired when you did will possibly wonder what the company saw in you that they thought could be made over into a general manager, and the young fire eaters may wait for a chance to test your nerve, but not a one of them that does not really wish you well at heart and not a difficulty that you cannot overcome by exercising tact. I do not believe it is possible for any man, however honest and square he may be, to do justice to himself or anybody else if he tries to look with one eye at the Brotherhood of Firemen or the Brotherhood of Engineers, and with the other eye at the superintendent or master mechanic. Either one or other of the optics will be pretty badly strained in the course of time, and eventually, both would become entirely useless.

I would not have you misconstrue my position as to labor organizations on railroads. I believe the particular orders which you are naturally affiliated with, are composed of honest men; that they are honestly conducted. I do not think they are a menace to the railroads; on the contrary, they are of assistance in asserting the sacredness of contract, in raising the standard of service, and in many other ways.

Now all this is commendable, I grant you, and it is not because I mistrust the motives of organization that I suggest you should withdraw from them, but otherwise you will be misjudged, and forced eventually to pay more attention to politics than to your legitimate duty, and I believe that once a traveling engineer, your next aim should be master mechanic, or superintendent, and one way to insure going ahead is to cut off all the avenues for going in any other direction. Some way should be provided for organizations to perpetuate your insurance; possibly, that is already done, and mark you this, more men would be promoted from organized labor, if organized labor offered more encouragement and support to their members who have ability and ambition. You are one of the first lieutenants of the army, if you please. You are expected to understand the rules and regulations and to exact obedience thereto—not with an ax—because it is one of your duties to educate before you admonish and admonish before you resort to harsher measures. Give confidence; trust the men and they will trust you; be square.

A great many changes have taken place in the manner of conducting negotiations between officers and men on a railroad. Individuality seems to be at a discount. About the only things our men ask for, personally, are passes or to be placed on the pension rolls, or to see that the payroll equals the record of their time slips. Everything else is done through a committee, and of late, the committee gets as far away as it can by delegating its desires to a general conference. One month we meet a federated body, and the next month the two parts of that same body notify us that they have hands and feet of their own and are liable to grow horns. Then, on the other side of the house, the officers associate, confer, look as wise as their salaries will justify, talk about the Declaration of Independence and the Battle of Bunker Hill, but in the end, I notice that human nature has endowed us all with a good many things in common. So over in the particular household that I hail from, we still cling to the belief that the personal factor never dies, although it seems to go to sleep and require a little shaking to wake up. I can recall the day when the general superintendent of the North-Western knew, personally, four-fifths of the employees; that is no longer possible, and the relations that were established directly, now have to be carried on through traveling engineers, trainmasters, superintendents, etc., and whatever may be the policies of your respective companies—and I will wager that they are alike humane, pacific and solicitous of the welfare of their employees—it is no small part of your duty to impress this policy upon those with whom you come in contact. I see men here to-day with whom I have been associated all my life; they have seen my hair grow gray, and I have seen theirs grow gray. Perhaps at odd times we have both done things that added to the other fellow's gray hair; but I would rather have their good will and confidence than the greatest office in the gift of any railroad, and I flatter myself they feel the same way toward me—or would if I did not make an occasional speech—and that is a condition, gentlemen, that I recommend you to nourish and cultivate on behalf of yourself as well as your company. * * *

Do not let your job overtake your education. You have read about great public men who obtained a start by teaching school, and they always had to study at night to keep ahead of their classes. Perhaps, some of you have had occasion to look up a few things in advance so as not to appear in an unfavorable light before your children. The art of anticipation is a great thing. If you keep one day in advance of the class, you can really make them believe you are a very wise man—I have tried that and recommend it highly. The company cannot afford to educate you as an officer only to go part way on the journey; they want and are entitled to the maturity of your judgment. You cannot afford to go through hardships of a subordinate officer's life only to fail by lack of education when you have nearly in your grasp that which always comes to him who toils and labors hard. Keep up your study, associate with those who know more than you do; do not confine yourself to technical things; inform yourself on business methods in general; be an all-around fellow; have visions of what you will be when you are general manager; prepare yourself to perform the duties of that office, and after awhile you will do some of those very things you dreamed about. Regard the company's material as if it were your own, your coal, your oil; see that they are used economically. Don't be afraid to be called a company man, nor a family man; there is no stigma about either one of them. People generally think well of a man who thinks well of his family, and they likewise respect a man who realizes his responsibility as trustee for the owners of a railroad, or anything else.

I have not pictured an ideal. A great many people fulfill all that I have said, and more too, and positions of great trust and adequate compensation will always be at the command of him who is honest, faithful and zealous.

*From an address by W. A. Gardner, Vice-President of the Chicago & North-Western before the National Association of Traveling Engineers, at its annual convention in Chicago.

The Ocean Carrier.

BY J. RUSSELL SMITH, PH.D.

In the space of a century and a decade from the time of our first census, 1790, to the last in 1900, the United States rose from a string of feeble commonwealths with a population of 3,929,214 to a world power of nearly 80 million people. That amazing 20 fold growth of the nation may serve as a parallel by which we can get some concept of the development that has taken place in the ship that served us at the two periods, but there is this difference, the ship has advanced faster than the nation; the present ship is 60 times bigger and several times faster than the prototype of George Washington's day. Taken on the even basis of ton for ton, the shipping of the present is five or six times as efficient as that at the beginning of the period under review.

This remarkable improvement is the result of a rapid evolution produced by the competition of sail and steam for motive power, and wood, iron and steel for material of construction. This double competition has made a rather complex result as an improvement in one of these fields often reacted in the other, and both have conduced to improvements in design that cannot be easily classified under either heading. One peculiarity of the century of progress is the fact that we have had revolutions without the destruction of the old type. As material for great vessels iron has replaced wood and steel has replaced iron, but wood continues to be used. Steam may be said to have vanquished sail but sailing vessels are still being built. The steps in the progress of this competition merit attention.

The rivalry between steam and sail is distinctly a rivalry between the modern and the old. For a thousand years man has hoisted a sail to be filled by the winds of nature which took him across the sea with all the fickleness and uncertainty for which the wind is famed. This motive power is cheap but it is variable, uncertain, may be adverse if there are zones of calms. The sailing vessel may make a short journey between Saturday and Monday, and on repeating the trip she may not reach port until Monday week. The fact that Providence furnishes the power gives the sailer cheaper costs of construction than the steamer and more

space to stow freight. The space taken by equipment is but one-twentieth in comparison to the steamer's one-third. The building of engines gives greater initial cost; their repair requires greater maintenance cost; their operation gives a fuel bill unknown to the sailer; and the operation of this mechanical ship requires a crew at least three-eighths larger than that of the sailer, and examples of best modern types would show crew rolls with variation of 100 per cent. between the two types. But the steamer has speed and a regularity that gives small heed to the ordinary whims of wind.

The object of the ship is transportation, and the users of transportation usually want to be able to know in advance the date of its performance. By this standard the slow and irregular sailer is found wanting for all exacting service. A few years ago it was declared that "the ratio of four to one" is "the present measure of the efficiency of steam tonnage compared with sail tonnage."* In this contest low cost and low efficiency is giving way to high cost and high efficiency.

A century ago the steam vessel was a dream of ridiculed enthusiasts and the world's commerce was using blocky old tubs with blunt ends and a width sometimes one-third as great as their length. Some of them had high bows and sterns, relics of the mediaeval fighting towers, and the average vessel was probably below 200 tons register. A few vessels were much larger than this; for example the "Grand Turk," 1791, with 564 tons, was a record breaker for American builders.

The rapid increase in our commerce during the period of the Napoleonic wars led to great increase in American shipbuilding, and Yankee ingenuity made great improvements in design. The decks were flattened and the vessel narrowed.

The period of the war of 1812 saw two suggestive changes in shipping technique. The almost constant danger of capture at sea by either French or British vessels made speed an essential for the American merchantman that was eventually to market its cargo. The war made privateering profitable and if the small privateer could catch a big merchantman or elude a big man-of-war, the returns of the business were likely to be good. Spurred by this impetus the American shipbuilder made astonishing improvements in speed. Baltimore seems to have been the leader in this and was long famed for her fast clippers. Two hundred and nine of these vessels went to sea as privateers during the war of 1812 and not one was captured.

Parallel with this came the general adoption of the steamboat to river use. Fulton's "Clermont" began on the Hudson 1807, the Delaware was shortly provided with a similar service; in 1812 the great Father of Waters was redeemed from its one-sided commerce that could only go downstream with the flat boat and the raft; and in 1814 there were five steamers on the Thames. The general adoption of steamers on rivers was almost immediate. During the 25 years 1815-1840 the steamer, feeling her way behind the protection of the shore, was gaining the necessary experience and receiving the needed perfection to sally forth upon the high seas and challenge the sail to the final contest for maritime supremacy. In 1809 the American flag was the first to be steam bourne upon the high seas, flying at the masthead of the "Comet" as she journeyed from New York to Philadelphia. In 1816 there was a line established from New York to New London, Conn., and one across the English channel from Brighton to Havre. The mail route from Ireland to Wales was a very important one, and the distance between Holyhead and Dublin is only 65 miles, but the sailing vessel service there often took three or four days and sometimes seven or nine days. In 1821 steamers were tried with such signal success that they were promptly used in various services to the continent and in British coasting trade. A Parliamentary report of 1822 showed that upon 30 coasting routes the average speed by steam was eight or nine knots per hour, and the voyage was completed in one-half to one-sixteenth the time required by sailing vessels.

It is interesting to note that at this time the steamers sailing upon the ocean were using the same side-wheel propellers that were in use on river boats, and they had the hulls of sailing vessels. The adaptation of the steam engine to marine use, and its improvement in efficiency were slow. The "Savannah," a sailing vessel with auxiliary engines, crossed the Atlantic in 1819 using her engines a part of the time. This mixed effort is commonly hailed as the beginning of ocean steam navigation, but the practical difficulties with such weak and heavy engines as then existed were such that it was 1838 before transatlantic steam navigation in a commercial sense may be said to have had its beginning in the repeated and successful voyages of the "Sirius" and "Great Western," which vessels, both British, one from Bristol, the other from Liverpool, practically had a race to New York and arrived within a few hours of each other.

In the meantime the sailing vessel had experienced great technical progress. The American shipbuilders had been stimulated to produce a fast boat by the dangerous commercial conditions existing between 1790-1815, and upon the return of peace and the increase of trade and travel after 1815 they began to study ship design in a scientific manner. As a result of experiment and copying the lines of fast swimming fish we soon evolved the packet ship, which was the finest sea-going vessel in the world. Until the middle of the century the maximum size of these vessels was about 1,000 tons register, and they could carry from 600 to 1,000 persons. The time to Europe was 19-20 days, which was two or three days better than the English vessels did, and there were records of crossing the Atlantic in 12 or 13 days. This superiority of the American packet over its rivals from other countries was so marked and so well recognized that it had a practical monopoly of the passenger, mail and express traffic. This superiority of the American sailor and his vessel is yet held in speed contests as witnessed by all the international yacht races of a half century.

The supremacy of the American and his sailing vessel was challenged by the British steamer. Nature made England maritime. Being set down in the sea within sight of the continent and of Ireland she had had excellent opportunity to practice in the steamer business in short journeys to neighboring lands. Twenty-two years of this, from 1816, when the first English channel line was established, to 1838, served for the accumulation of enough experience for the successful mastery of the problem of crossing the Atlantic in a real steamer. The Atlantic race of the "Sirius" and the "Great Western" mentioned above was the real beginning of transatlantic steam traffic which has, with very short breaks during the first winters, been continuous from that time. The "Great Western" kept right on, and while the "Sirius" returned to her old work in British coasting trade other vessels were quickly built to get a share in the novelty traffic for the rates on the new steamers to New York were high. The British Government became convinced of the feasibility of the Atlantic steamers for the mail service, and having been long in the habit of advertising for private offers for the mail service, a mail subsidy was offered by the government and taken by Samuel Cunard, the founder of the Cunard line. Steam vessels and lines rapidly multiplied, but mechanical and architectural improvements had to come first.

The paddle wheel is admirable for river traffic but it is ill-adapted to the ocean, where the rolling vessel often has one wheel clear of the water and the other deeply buried. There was at the same time dissatisfaction with wood as a material for the larger vessels that were desired in the transatlantic trade. There had been some occasional experiments with iron vessels from 1777, but they had their practical beginning about 1830, and one of 600 tons was built in 1837. These experimental vessels easily overcame the idea that an iron boat being of heavy material must sink. Iron boats not only float but are actually lighter than wooden vessels of same size, and therefore have more buoyancy. The iron vessel can be strengthened at the desired point easier than the wooden one, and the comparison of a few wrecks soon proved that the iron vessel could stand more pounding and had a stronger hull than a wooden vessel. The fact that the iron of the hull disarranged the compass was an effective barrier to an open sea journey until 1839, when an improvement in the compass made that invaluable instrument workable on iron ships. The way was now open for the use of iron on any vessels, and in 1840 the famous engineer, Brunel, designed the "Great Britain," an iron giant of that day, built for the New York trade. This vessel of 2,984 tons was an innovator in size, in material and in mechanical equipment, for she was driven by the screw propeller, a device that had been proved efficient in 1836 by John Ericsson. The "Great Britain" was a success, but Brunel was rather ahead of his time. He had seized upon new processes that had, like most improvements, to make their way gradually. As late as 1359 the same Brunel built the "Great Eastern," which had both screw and paddle wheels. The slow adoption of iron was due in part to the conservative influence of the Cunards, the leading line of Britain, and the one enjoying the government subsidy. This company built wooden paddle-wheelers while Brunel built the "Great Britain," and the Cunards only adopted iron hulls in 1856. The screw came into general use about 1850. In 1853 iron was the material used in building one-quarter or more of the vessels built in Great Britain and one-quarter were propelled by steam.

The American Civil War developed the ironclad and introduced iron to the war fleets of the world. The economic situation in Great Britain made that country the leader in iron merchant vessels. She was devoid of forests and supplies of timber, but was the world's leader in the manufacture of iron. Consequently the transfer to iron ships was rapid and in less than half a century the disappearance of wooden ships in British yards had become complete. A similar period served for the disappearance of iron as building material, for in 1875 experiments showed the suitability of steel, which is merely a better form of iron. In four years the new material was used in one-tenth of the new vessels built on the Clyde, and in 10 more years its virtue was so widely recognized that its use in new vessels was well nigh universal, amounting to 97 per cent.

*Report of U. S. Commissioner of Navigation, 1903, p. 181.

The change from wood to iron did not come so rapidly in the United States as in Great Britain. We were exporters of wood and importers of iron; we had the equipment for building the wooden ship, and our wooden ship was the best in the world. During the civil war the industry of the country was paralyzed, and since that period our merchant marine has been in a state of low development when it was limited largely to the coasting and sailing vessel trades. Here wood had its stronghold, and when Great Britain had entirely ceased to build wooden vessels they still outnumbered iron in this country 1½ to 1.

The accompanying table of materials shows the progress of the different materials in the world's needs since 1890. That is a period during which new building has been predominantly of steel, as is shown by the 560 per cent. increase in tonnage. Wood and iron have decreased respectively 52 and 40 per cent. These are not exact measures of the virtue of the two materials, for wood has been used as material of construction much more than iron, so that vessels of wood have been replenished while those of iron have not been affected much by any factor except the natural reduction of tonnage existing in 1890. The life of a wooden ship is short in comparison to iron. There are some cases of wonderful longevity of wooden ships, the century mark even having been reached, but the East India Company had a general rule that the life of the ship in their business was eight years, and that she was then sometimes worth repairing for four more years of service. The life of an iron ship has scarcely been determined on the basis of life of material,* but they are steadily being broken up because they are obsolete and incapable of competing with the newest types embodying the results of a half century of progress in motive power and design. These improvements in power and design have been made in both steam and sail.

Materials of World's Merchant Marine.

(From annual report Commissioner of Navigation, 1904, p. 253.)

		Wood.		Iron.		Steel	
Year.	Power.	No.	Tons.	No.	Tons.	No.	Tons.
1890.	Steam	902	360,147	7,719	8,495,920	2,343	4,086,555
	Sail	18,924	6,693,738	1,879	2,021,593	248	348,653
		19,826	7,053,885	9,598	10,517,513	2,591	4,435,208
1895.	Steam	1,007	306,911	7,099	7,432,890	4,994	9,038,000
	Sail	14,526	5,173,766	1,671	1,778,671	801	1,185,101
		15,533	5,534,677	8,770	9,211,561	5,795	10,223,101
1900.	Steam	1,158	382,131	6,262	5,915,714	8,286	15,999,406
	Sail	9,970	3,627,491	1,386	1,482,388	1,082	1,509,298
		11,128	4,009,622	7,648	7,398,102	9,368	17,508,704
1904.	Steam	1,289	419,956	5,684	5,067,025	11,299	23,072,876
	Sail	8,201	3,035,654	1,195	1,280,293	1,352	1,792,974
		9,490	3,455,610	6,879	6,347,318	12,651	24,865,850
Per ct., 1904 to 1890			48	.....	60	.....	560

The marine engine has been improved more than the hull since the first vessel steamed across the Atlantic. In 1899 an old steamer was torn up and her engine weighed 17 times as much per horse-power as the then best type. The Atlantic racers of 1840 had a boiler pressure of 13 lbs. per sq. in., and passed the steam from the cylinder where it did the work directly to the condensers. The compound engine passes the steam from the first cylinder, where it has great pressure, to a second cylinder with greater size and less pressure per unit of area. The pistons from both cylinders drive a common shaft, but the connecting rods exert their pressure upon it at different angles and there is an interval of time between the strokes of the two pistons. The available power from a given amount of steam is not doubled but it is considerably increased. The compound engine was applied in Glasgow in 1856, was put into vessels in China trade in 1865, and was generally adopted about 1870. Boiler pressures were raised until 200 lbs. per sq. in. became common in the last decade of the nineteenth century; the compound or double-expansion engine was followed by the triple-expansion, and it in turn by the quadruple-expansion engine. In the 65 years from 1840-1905 the improvements just mentioned, along with better combustion by forced draught, the return of heated water to boilers and many minor improvements have reduced the coal required for the horse-power hour from 5½ lbs. to about 1 lb., and the end is not yet. Theoretically the best engines are yet getting but one-fifth of the power from coal.

The turbine is apparently opening a new epoch in steam navigation. With the new Cunarders it leads the world in size and speed of vessels. It makes no great saving in coal but it uses its power advantageously. It is smaller and takes up much less space. It is simpler, occasions less friction, less wear and repair. Its operation is quiet. Like an electric motor, the parts are balanced.

Another improvement of great value has been the division of the ship into water-tight compartments, of which one could be filled with water and the ship, buoyed by the remaining seven-eighths or eleven-twelfths of her hull, still float in safety. This also enables the ship to have separate engines and engine rooms, so that one of these may be flooded and the other run steadily onward. Double engines mean twin screws, which under all circumstances are great guardians of the ship's safety. The modern steamer dependent upon one screw is helpless with a broken shaft. With twin screws she proceeds at something more than half speed and a calamity is turned into a mishap. The twin screw is therefore the usual thing on passenger ships; the new turbine Cunarders have four screws.

During the two-thirds of a century that have elapsed since the "Sirius" and "Great Western" raced to New York in 1838 the designers of sailing vessels have not by any means been idle. The sailing vessel is still with us and during the first 50 years of the oceanic competition she held her own numerically at least, and it is only in the last 15 years that she has had to go down ingloriously before her steaming sister.

The steamer with hull and machinery has a greater field in which to perfect improvements, and it is really remarkable how much the sailing vessel has been improved under the goading competition of advancing steam. Iron and steel were found to be quite as usable in the construction of sailing vessels as in steamers, and these materials have been adopted, although it did not come as promptly as was the case with steam vessels. The spreading of sails to the wind seems to be a simple process, but it has been improved almost as fast as the devices for harnessing steam. The typical sailing vessel of 1850 was a square rigged ship—a vessel with several spars at right angles to each of several masts and many square sails high aloft. Much rigging held this complex harness together, and the numerous sails were set and reefed by many men far aloft at the risk of their lives. The thousand-ton "East Indiaman" of 1850 had a crew of 80 hands, a 2,500 four-masted barque of 1900 had 33 hands. Taking the figures for the British merchant marine for 21 years it appears that the sailing vessel has actually reduced her crew faster than the steamer. For British vessels engaged in the foreign trade the number of crew per 100 tons net register has been as follows:

	1880.	1890.	1898.	1901.	Per cent. reduction.
Sailing vessel	2.32	1.96	1.65	1.61	31
Steamer	2.95	2.73	2.32	2.22	25

These figures from the British marine are but averages of many vessels of all ages and do not cover the case as accurately as would figures which described only the most modern types.

The British figures refer too much to the fast disappearing square rigged ship which promises to disappear from the competition of the typical American sailing vessel, the schooner. The advantage of this rig* lies in the absence of the yards and spars. The sail being fastened on one side of the mast only and supported by booms and gaffs that swing upon the mast as a pivot. Each mast has a small top sail and one great sail which can be hoisted by a rope from the deck. This is a safe process and one in which men can work to good advantage. This vessel was evolved by the Gloucester fishermen about 1745. In 1800 these fishing schooners were of from 20 to 40 tons, and soon after they began to be used in the American coasting trade. By 1860 the typical coasting schooner had two masts and was of about 250 tons burden. If she were made larger the raising of anchor and sails required more men than were needed at any other time.

A three-masted schooner had been built in 1831. By 1850 they had passed the experimental stage, and by 1870 they were the prevalent type, ranging from an average size of 300 tons to 700 for the largest. Then followed one of the most striking of modern ship developments. The masts began to be multiplied. In 1880 a four-masted schooner was built; in 1888 came the five-master. A representative of this pattern, built in 1899, carries 4,000 tons of cargo. In 1900 came a six-master carrying 5,500 tons. All these were of wood and the center of construction was the coast of Maine. In 1902 the present climax was reached in the launching of the "Thomas W. Lawson," a seven-masted schooner built of steel and carrying 7,500 tons of cargo with the amazingly small crew of 19 men. Of this vessel, recently wrecked, three decks were of steel, 135 ft. of the 193 ft. of mast was of steel; the standing rigging was of steel, and the sails were hoisted by steam. The steering gear was steam-driven. In this steam crew lies the secret of the small force of men aboard, and the ultimate value of the American schooner, if she is to have any ultimate value, lies in the fact that she is of such a design that she can use auxiliary steam to harness the wind as she spreads her acre of sails. The net result of the working of all these factors in the competition for the motive power is shown in the accompanying statistics of the world's merchant marine for a period of 32 years.

Table I. shows that since 1873 the steam tonnage of the world

*The career of the "Great Britain," the first iron Atlantic steamer is interesting proof of this fact. She was launched in 1843, spent the winter of 1846-7 ashore on the rocks of the Irish coast, was re-engined, spent 22 years in the Melbourne trade, and was converted into a sailing vessel in 1882, and in 1895 she was reported as doing service as a coal hulk at Falkland Islands.—See Henry Fry's "History of North Atlantic Steam Navigation," p. 43.

*Any good unabridged dictionary gives cuts of the various and numerous varieties of sailing vessels which are named in accordance with the method of sail arrangement, i. e., the rig.

and of all countries has increased enormously and steadily. The average for the world being 336 per cent. for a quarter of a century, average of over 100 per cent. for each of the three decades. During the time of this great absolute increase in steam tonnage, the sail tonnage, as shown in totals in table II. or in detail in table III., declined absolutely. This decline of 40 per cent. in the world's total was not relieved by a gain in any single country, nor did any country hold its own. Norway having her forests and her lumber trade held out the longest, but with the new century her sail total fell. Table IV. shows that most of the relative and absolute decline of the sailer has come since 1890. Before that time the efficiency of sailing vessels as cheap freight carriers enabled them to outrank steamers in total tonnage, but the latter half of the decade, 1880-90, was the period of the general adoption of steel hulls and triple-expansion engines. With these improvements in the steamer the sailing vessel could not compete and building fell off in favor of the improved steamer. The relative proportions of steam and sail at different periods show the newness of steam predominance. In 1874 sailing vessels were to steamers as 4.7 to 1, in 1890 1.2 to 1, in 1904 .34 to 1. Expressing it in percentages, it appears that 18 per cent. of the world's shipping was propelled by sail. From the standpoint of work done, the application of the old rule of efficiency of 4 to 1 in favor of sail, shows that sailing vessels are now doing but 5.3 per cent. of the world's ocean carrying.

In 1901, 1902 and 1903 steamers carried many cargoes of Pacific coast grain to Europe. It was, it is true, done at a loss, but such periods come rather frequently in the shipping industry. It is not being claimed here that the steamer promises immediately to replace the sailer in this trade, but it has already competed for full cargoes. Much more significant is the consolidation of all sailing lines between the two coasts of America, and the sale of these vessels and their replacement by high type steamers. Freight carrying perfection is illustrated in the new American steamers that have been built to replace the sailing vessel line from New York to San Francisco. Some of these vessels can carry 10,000 tons dead weight of freight and 2,500 tons of coal. If the Panama canal were open it is expected that they would make the 5,000-mile voyage from New York to San Francisco at nine knots per hour with 1,000 tons of coal, or one ton of coal for 10 tons of freight. With coal at $3 per ton, the coal cost of a ton of freight carried 5,000 miles would be 30 cents. Small wonder that a man interested in these steamers exclaimed, when comparing them with sailers, "Oh, the coal is a bagatelle." Upon the opening of the Panama canal the sailer will probably be entirely displaced in the Atlantic-Pacific trade by the apparently impossible task of competing around Cape Horn with a steamer passing through the canal, and saving more than half of the distance.

The route from New York to Australia was claimed by Lieutenant Maury, the great ocean expert of 40 years ago, as the perpetual home and exclusive possession of the sailer. The route is long, the winds are fair and coaling stations for the rival steamers are scarce and expensive. But when the trade turned against the sailers this stronghold was also invaded. In the year 1896 several lines added steamers to their service, and have maintained them for 11 years and are shipping a large part, indeed the greater part, of the freight by them.

It appears from the statistics of 1904-5 that there has been a pause in the downward course of sail tonnage. During the five years, 1899 to 1903, the total decline was not much greater than the annual decline from 1890 to 1899. This halt was due largely to the great boom of 1898 and 1899, which made every kind of vessel profitable in the extreme, and produced the greatest increase of steam shipping ever known. Steam and sail alike were profitable, and were built wherever the equipment was available, and the decline of the sailer was stayed, but the figures for 1904 show that the boom influence is over and that the upward march of steam and the downward march of sail tonnage has begun again.

The multimasted schooner with minimum crew and steam, sail and steering gear is spectacular, and has been heralded as the beginning of a renascence of the sailer. These vessels are not being built very rapidly, and in the steamers there is the counterbalancing improvement of oil-burning engines which require less space and less crew. There is also a mechanical stoker in use and the turbine is apparently coming. There does not appear to be any contrivance in sight to increase the force of sail competition with steam, and increasing disadvantage appears likely.

The extinction of the commercial sailer is not predicted here. For a long period to come there will be some distinctly sailing vessel work, but further decline of tonnage seems evident. She cannot hold her paltry twelfth part. In 1902 the British steam tonnage increased 708,000 tons and the sail tonnage declined 65,000 tons. The traffic upon which the sailing vessel has the strongest hold is some irregular and spasmodic trade, both coasting and foreign, which cannot be organized and handled as line traffic. The beginning of a new trade may be the occasional departure of a sailing vessel. Such a trade is now arising between the Gulf ports of the United States and the La Plata ports. If it grows, a line of steamers will take it over and most of the sailers will be displaced, giving another reduction to sailing tonnage.

There are times when the sailing vessel is desired because the low speed and consequent long voyage enable the shipper to save storage expenses at one of the termini, but the competition of a seaworthy ship as a mere storage warehouse is not a strong foundation for continued prosperity.

(To be continued.)

Table II.—*Seagoing Steam Tonnage of the World.*
Répertoire Générale of the Bureau Veritas for 1904-'05.

Countries.	1873-'74 Tonnage.	1873-'74 Per cent.	1878-79 Gross tonnage.	1878-79 Per cent.	1888-'89 Gross tonnage.	1888-'89 Per cent.	1898-'99 Gross tonnage.	1898-'99 Per cent.	Inc., per ct., 1873-'74 to 1898-'99.	1904-'05. Gross tonnage.
Great Britain	2,624,431	60.4	3,465,187	62.4	6,873,552	62.3	10,993,111	58.5	311	14,889,175
United States	483,040	11.2	609,101	10.8	535,345	4.8	810,800	4,2	68	1,720,176
France	316,765	7.4	335,219	5.9	752,028	6.8	952,682	5.1	200	1,266,486
Germany	204,894	4.8	253,667	4.5	662,331	5.9	1,625,521	8.3	693	2,887,130
Spain	138,675	3.3	152,708	2.7	395,685	3.5	520,847	2.7	275	713,775
Italy	85,045	1.9	84,421	1.5	276,326	2.5	420,880	2.2	395	735,212
Holland	72,753	1.7	116,149	2.0	197,748	1.8	363,200	1.9	399	631,600
Russia	67,522	1.6	104,702	1.8	163,556	1.5	358,415	1.8	430	637,114
Norway	41,602	0.9	53,331	0.9	160,558	1.4	628,493	3.3	1,410	1,030,637
Japan	.....	...	.....	...	115,088	1.0	439,509	2.3	...	645,998
All others	293,466	6.8	420,690	7.5	913,720	8.3	1,773,674	9.5	504	2,743,174
Total	4,328,193	100.0	5,595,175	100.0	11,045,937	100.0	18,887,132	100.0	336	27,900,457

Table III.—*Seagoing Sail Tonnage of the World.*
(Same authority as table No. 1.)

Countries.	1873-'74.	1878-'79.	1888-'89.	1898-'99.	Per ct. dec., 1874-'99.	1904-'05.
Great Britain..	5,320,089	5,596,018	4,215,634	2,910,555	45	2,080,243
United States .	2,132,838	2,075,832	1,913,090	1,285,859	40	1,465,819
Norway	1,137,177	1,374,824	1,328,296	1,144,482	0.6	749,354
Italy	1,126,032	963,625	718,889	463,767	59	523,910
Germany	893,952	914,674	737,028	535,937	40	506,101
France	768,059	595,933	352,418	279,412	64	494,123
All others	2,807,689	2,796,524	2,370,934	2,073,757	26	1,993,498
Total	14,185,836	14,317,430	11,636,289	8,693,769	40	7,812,957

Table IV.—*The World's Merchant Marine.*
[Recorded in Lloyd's, 100 tons or over.]

Year.	Steam No.	Steam Net tons.	Sail No.	Sail Net tons.
1890	11,108	8,295,514	21,190	9,166,279
1893	12,588	9,622,610	19,452	8,983,957
1894	12,907	10,111,769	17,814	8,503,294
1895	13,256	10,573,642	17,112	8,219,661
1896	13,652	11,027,603	16,228	7,876,264
1897	14,183	11,531,829	14,168	7,300,839
1898	14,701	12,073,074	13,351	7,049,958
1899	15,324	12,935,994	12,856	6,795,782
1900	15,898	13,856,513	12,524	6,674,370
1901	16,528	14,874,253	12,563	6,591,627
1902	17,156	16,026,372	12,472	6,577,776
1903	17,761	16,822,466	12,182	6,459,766
1904	18,467	17,682,141	10,823	6,156,505

This decline has been general, not local; it has affected the shipping of all countries, the trade of all oceans and of almost all commodities.

The claim is often made that there are special commodities and particular routes that belong exclusively to the traffic of the sailing vessel. Conspicuous among commodities supposed to belong to the sailer are nitrate of soda from Chile, lumber in the American coasting trade and elsewhere, and wheat from San Francisco. Within the past decade the shipment of full cargoes of nitrate by steam has become common, and several lines of steamers regularly carry it as a large part of their return cargo. Special steamers have been built to carry Carolina pine to New York and New England, and the shipments* of pine lumber and ties from the port of Savannah, Ga., for seven months, April 1-Nov. 7, 1905, show the following results:

	Steam, Million ft., B.M.	Sail, Million ft., B.M.
Foreign	4.74	0.36
Baltimore	10.13	4.93
Philadelphia	5.26	5.95
New York	23.82	15.91
Boston	3.16	5.81
Other ports	.....	7.40
Total	47.11	40.66

*N. Y. *Lumber Trade Journal*, Nov. 15, 1905, p. 22.

GENERAL NEWS SECTION

NOTES.

The New York, New Haven & Hartford is now running state-room sleeping cars between New York and Boston.

At Jersey City, N. J., last week a street railroad company was fined $50 for violating the city ordinance requiring that every passenger be furnished with a seat. The case will be appealed to the Supreme Court.

The application of the railroads of Mexico for permission to increase their rates on ores is to be granted but, according to reports, the government will not permit the higher rates to go into effect until April 1.

The Pennsylvania Railroad has discontinued sending through freight trains over its Portage line, and, according to press despatches, the result will be the dismissal of several hundred men at East Hollidaysburg.

The Cincinnati, Hamilton & Dayton last week ran an "Agricultural special" over its line, making a three days' journey and stopping at the principal towns where farmers could be gathered. Lectures were given on the best corn to plant in Ohio and on the value of alfalfa.

The Long Island Railroad Co. has notified the New York State Public Service Commission that demurrage charges on cars at Long Island City and at certain other stations would be at once abolished. There is now no serious congestion of freight and consignees will be allowed to take their time in unloading their goods.

The New Jersey State Railroad Commission in its first annual report recommends the granting of increased power to the commission in certain directions, but does not favor granting to a commission the power to regulate rates. On this last point Commissioner Whiting dissented and made a minority report advocating the passage in New Jersey of a law similar to that now in effect in New York.

By lengthening 24 passing tracks between Roseville, Cal., and Truckee, the Southern Pacific has increased the capacity of its main line eastward from Sacramento almost 50 per cent., these passing tracks, now 2,600 ft. long, being able to accommodate 45-car trains, whereas before trains were limited to 30 cars each. The company has during the past year increased its freight car capacity 20 per cent. and its locomotive power capacity about the same.

The attempt which was made at Pittsburgh last week to require street car passengers to pay their fare on entering, broke down before the end of the second day. Many passengers offered $1 and $2 bills and insisted on stopping for their change, and the tracks were blocked with cars for long distances. One conductor, who encountered a woman holding a nickel between her teeth, is said to have succeeded in pushing the coin down her throat; and several conductors threw up their jobs.

The Committee on Car Efficiency of the American Railway Association, Arthur Hale, Chairman, has issued a statement of car surpluses and shortages on December 11, showing an aggregate surplus of cars amounting to 119,339 and an aggregate shortage of only 4,520. As there is now a surplus of cars everywhere the committee will discontinue detail bulletins, but will issue, fortnightly, condensed bulletins; and the Chairman will, on request, furnish details for particular roads, where desired.

According to a press despatch from Chicago the Atchison, Topeka & Santa Fe has changed 200 oil-burning locomotives into coal burners because the Interstate Commerce Commission rules that one railroad must not carry fuel for another without compensation. This apparently is meant to be taken as indicating that some other company (the Southern Pacific?) has such a warm interest in the prosperity of the Atchison that it is willing to carry fuel for it without charge. Thus the Government at Washington, by its cold and unfeeling decision, chilling the milk of human kindness in the breast of a corporation, dries up the springs of the oil traffic in southeastern Texas.

President Roosevelt has awarded a railroad life saving medal to Edward A. McGrath, of Milwaukee, station agent of the Chicago, Milwaukee & St. Paul at Beecher street, in that city. He is a cripple, his left leg being about 8 in. shorter than the right one, making it necessary for him to wear a piece of wood on the bottom of his shoe to make his legs of even length. On the 26th of August while he and others were standing on the platform, the crossing gates being closed for the passage of a train, a six-year-old girl attempted to cross the track in front of the approaching train. McGrath shouted to her to stay back, but she did not heed his warning. McGrath at great risk to himself ran to her aid and succeeded in lifting her from in front of the approaching train just as it rushed by. McGrath was struck by the pilot beam of the engine, but escaped serious injury. The child was entirely uninjured.

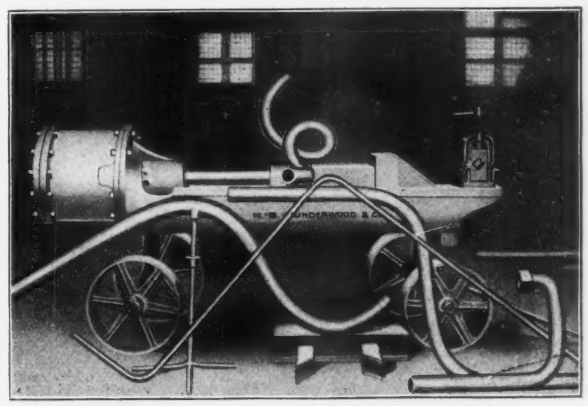
Southern Pacific Orange Traffic.

Besides buying this year 6,600 of the best refrigerator cars for its California fruit traffic, the Southern Pacific has taken up the problem of cooling the fruit before it is loaded. The company has begun building pre-cooling plants, and also ice-making plants to supply its cars. When pre-cooling comes to be general a large amount of fruit will be saved that now becomes spoiled, and fruit can remain on the trees longer. It is expected that pre-cooling will add from 10 to 20 per cent. to the value of California's citrus fruit production, which, in the season just closed, brought $34,000,000, and made the total fruit crop of the state worth twice as much as her gold production.

All-the-year-round demand for oranges has increased to such an extent that California growers have found it necessary to propagate more very early and very late varieties, until now there is hardly a day in the year in which citrus fruit shipments are not made from this state. The bulk of the crop, however, is handled between January 1 and July 1. For the fruit season ending Nov. 30, the total number of cars of oranges shipped was 23,984, and the increase for all citrus fruits was 2,000 cars for the year.

Pneumatic Pipe Bending Machine.

The accompanying illustration shows a portable pneumatic pipe bending machine made by H. B. Underwood & Co., Philadelphia, Pa. It has been in use for some months in a large railroad repair shop, where it does all the pipe bending required in equipping



Pneumatic Pipe Bending Machine.

locomotives, including the air-brake piping. It makes a right angle bend in a 2-in. pipe in two minutes and does not flatten or injure the pipe in any way. Dies of standard radius for locomotive work are furnished for pipe from ½ in. to 2 in. diameter, while special dies of any required radius or shape can be made to order.

New York City Slow.

Three thousand suburban travelers living along the line of the Western Railroad of France, exasperated by continued delays in transit through which, they allege, they lose hours in pay daily and sometimes even are dismissed by their employers, wrecked the offices at the St. Lazare terminus of the railroad Jan. 3, and for an hour held the police at bay. They were finally dislodged by the Fire Department, which played on them streams from two lines of hose.

Supply and Demand in the Labor Market.

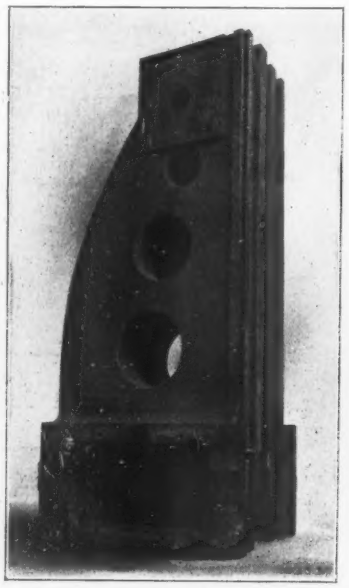
Mr. Gompers is reckoning without his host when he says that the wages of organized labor will not have to come down along with the prices of raw materials in the present general business and financial depression. The inexorable law of supply and demand will make itself felt in the case of organized labor, as well as in all other branches of business, Mr. Gompers notwithstanding. Labor has been at a premium for the last four years, and it has also been less efficient that ever before. All classes of employees have pointed to the heavy earnings and, in consequence, have received their share in the shape of higher wages. Mr. Gompers overlooks the axiom that when labor is at a premium the employee is in a position to make terms with the employer, but when labor is at a discount, as it is

now, the employer is the dictator. In the immediate future employers will have more to say about the scale of wages than for several years, provided the present business recession obtains, as now. The price of unskilled labor has already declined.—*Interview with F. D. Underwood.*

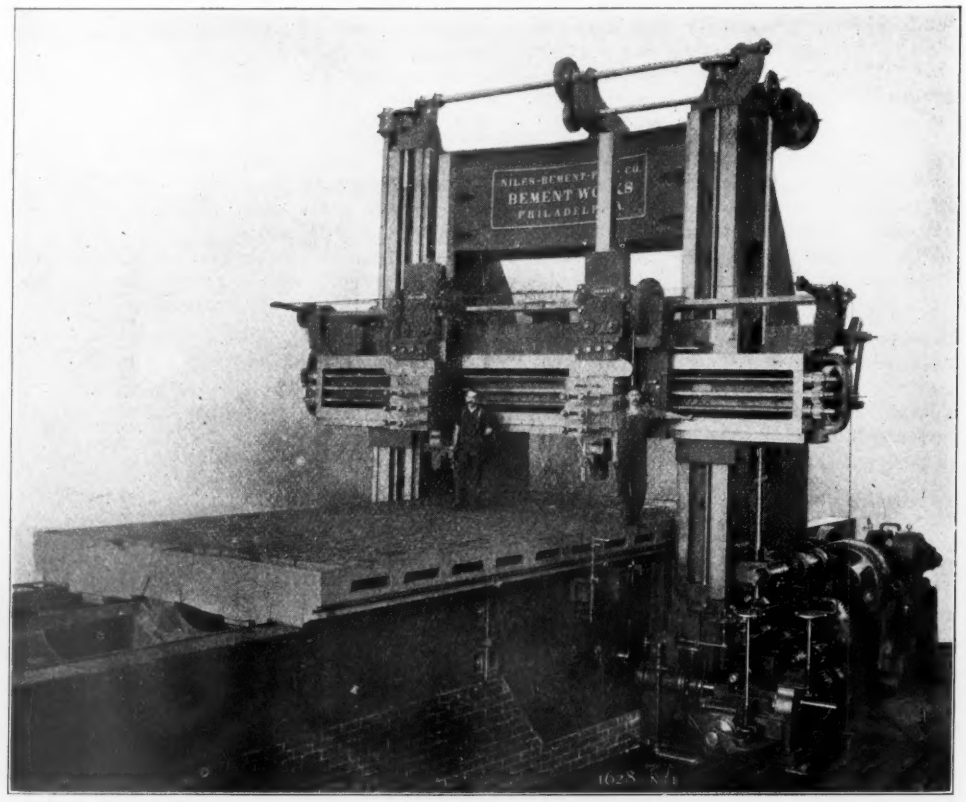
An Enormous Planer.

The planer shown in the accompanying illustrations was recently built at the Bement Works of the Niles-Bement-Pond Co., New York, for the Mackintosh-Hemphill Co., of Pittsburgh, Pa. It weighs 845,000 lbs., and the motors used to drive it aggregate 207½ h.p. It is 14 ft. 4 in. wide between uprights, and the distance from the top of table to the under side of the cross rail is 12 ft. 2 in. The stroke of the table is 30 ft. The main drive is by a 100-h.p. motor, attached to the base of the right-hand housing. It has a slight variation in speed and further changes can be made by the gears. Power is transmitted by gearing from the motor to reversing multiple disc pneumatic clutches. A small valve controls the starting, stopping and reversing, the valve being tripped by table-dogs for automatic reverse. Inside of the bed is a part of the driving mechanism, consisting of two large steel bull wheels, which engage with two racks on the table. The pinions driving the bull wheels are cut directly on the forged shaft with teeth spaced half pitch apart. Faces of pinions, bull wheels and racks are 15 in. wide.

In general the machine is of the usual type, but has several unusual features, in addition to the reciprocating table motion. Slotter bars, with 8-ft. stroke, are carried in the rail heads. One of the heads also has a power reversing cross motion for transverse planing, while both have quick power traverse on the rail, as well as tool slides in heads for quickly bringing them to approximate positions. When slotting certain classes of work the table has to be intermittently fed as on a regular slotting machine. The motor for the slotting and cross planing motion is 50 h.p. It has a slight speed variation, and there are change gears to further alter cutting speed the same as for the table driving motor. This smaller motor is near the base of the left-hand housing, and drives pneumatic clutches of smaller size, but similar to those on the driving side. Power is transmitted through bevel gearing to a vertical shaft, which is made square to eliminate the use of sliding keys under great torsional strain. Above the motor is a disc driven from the main train of slotter gearing. It has adjustable stops on its circumference which are set to control the length of stroke just as dogs on a planer table.



The Two Uprights of Niles Planer.



Planer; Niles-Bement-Pond Co.

The short vertical column attached to the right-hand side of the bed consists of an inner shaft and a sleeve. On the upper end are two sockets, in one of which is a handle. The upper socket is attached to the inner shaft, which connects with the rod for controlling valve and pneumatic clutches for slotter bars. The lower socket is attached to the sleeve, which controls the movement of table for regular planing, and is connected by lever and rods to the automatic reversing dogs on both sides of the bed. This control is duplicated on the other side of the planer. Only one handle is provided for each side, and thus mistakes arising from operating the wrong lever are avoided.

The uprights are massive castings 25 ft. high, 12 ft. deep, where bolted to bed, and with vertical faces 30 in. wide. Mounted on the uprights is a cross rail 5 ft. high and long enough to allow full traverse of either head between uprights. On this rail are heads with counterweighted tool slides 7 ft. 8 in. long, having a vertical traverse of 4 ft. The tool aprons are of steel 28 in. wide, with three slots for clamp bolts, and are arranged to swivel in the usual manner. Horizontal quick power traverse of heads on rail or vertical traverse of tool slides is operated by a 7½-h.p. motor, placed on the right-hand end of the cross rail. A 20-h.p. motor for raising and lowering the cross rail is at the top of the right-hand upright.

Pneumatic feed was adopted because of the great weight of the work and the table which must be fed across the bed when slotting or cross planing. On the side of the right-hand upright is a cylinder, whose piston-rod connects with a rack which meshes with a gear near the bottom of the vertical feed shaft. The feed shaft has on its lower end a bevel-gear meshing, with another bevel gear on a horizontal shaft, which transmits motion to the vertical feed shaft on the left-hand upright. The movement of these feed shafts is constant at all times, and amount and direction of head feeds is controlled by adjusting the connecting rod in the slotted cranks on the ends of the cross slide. Feed cranks are graduated, so that definite cross and vertical feeds can be obtained, and by using the cranks on both sides at the same time an angular feed can be given to the tool, which is at times desirable, as the complete heads were not designed to swivel. The feed mechanism for table necessary when slotting or transverse planing is directly in front of and at the base of the right-hand upright. This feed works much the same as the feed for the cross head, except that variation in stroke or amount of feed is obtained by an adjustable stop, which regulates the movement of the piston. The machine has its own air compressor, driven by a 30-h.p. motor.

The table is 32 ft. long, 14 ft. wide and slides on three ways each 15 in. wide, the center way being V-shaped and outside ways flat. The bed is 60 ft. long, 13 ft. wide and 73 in. deep at center. Because of the great weight and large dimensions, it was impracticable to make the bed or table in one piece. The central section of the bed is divided longitudinally into three parts, and the two end sections into two parts each. The weight of the bed is about 275,000 lbs. The table is made in two sections, divided longitudinally in the center, and weighs about 140,000 lbs.

INTERSTATE COMMERCE COMMISSION RULINGS.

Beer and Water Not to be Mixed.

In an opinion rendered by Chairman Knapp the Commission has announced its decision in the case of the Milwaukee-Waukesha Brewing Company against the Chicago, Milwaukee & St. Paul and others. Defendants refused to apply carload rates on carloads made up of less than carload lots of mineral water and beer. Upon the

facts disclosed, and principles announced in the recent case of Paper Mills v. Pennsylvania Railroad, the Commission decided that the refusal of defendants has not been shown to be unlawful. The complaint was dismissed.

Railroad Papers to be Preserved.

An order has been issued by the Commission to the effect that until further notice all records, documents and papers bearing on the statistics and accounts of railroads, with certain exceptions, shall be kept as a permanent file and in such manner as to make them easily accessible at all times for inspection by a properly accredited examiner of the Commission.

Certain papers that may be destroyed are indicated in the order. Among these are tissue copies of statements, waybills or reports, duplicate detached reports, used or canceled tickets, waybills dated before January 1, 1889, and conductors' and waiters' checks. Among the papers that may be destroyed after having been retained in the files for three years are train conductors' reports of train and car movements, detached papers relating to labor and material and papers subordinate to payrolls, including time checks and excepting time books.

Dining conductors' trip reports, daily reports of service of mechanical department employees and daily reports of service of transportation department employees may be destroyed at the expiration of six months after a carrier which has given previous notice of such purpose in writing to the Commission shall have received formal acknowledgment of such notice.

TRADE CATALOGUES.

Engineers' Hand Book on Rolling Doors.—This is catalogue No. 34 of the James G. Wilson Manufacturing Company, No. 3 West 29th street, New York, and it can be obtained free; nevertheless the title given it is a correct one. It contains 31 large pages of detail drawings which the engineer can ill-afford to do without in planning locomotive roundhouses, sheds and shops, car barns, freight houses, pier sheds and the like—wherever openings are to be covered and uncovered by fireproof or other construction efficiently and without waste of space. There are also about 60 good photographs, valuable in showing the varied applications in many kinds of building construction. Rolling doors are made of wood, bronze, iron or steel, and are flexible, so as to easily lift and coil in a roll over the opening. The engineer is more directly interested in two forms: The corrugated steel, a solid sheet, but flexible enough to roll up, and with malleable-iron clips which prevent wear in the guides; and the interlocking slat doors, with the same malleable-iron protection, more flexible and easier worked. It is out of place here to attempt giving more than a notion of the variations in details in making these applications to meet differing conditions. For example the Northern Pacific shed, at Seattle, has bays with shutter-covered openings 19 ft. wide; one at Baltimore 24 ft. wide; a car barn at Mt. Washington, Pa., with an opening 30 ft. wide. These involve considerable weights in the broad steel shutters to be lifted and lowered. They are counter-weighted or spring balanced. They are commonly operated by a winch, conveniently located, but small electric motors are frequently used. The methods of automatic closing of fireproof doors, when unusual heat comes from an accidental fire, are interesting. Indeed the whole catalogue is interesting.

The Union Pacific passenger department has made up a brief statement regarding the irrigation projects on and tributary to that road and its related lines under consideration and construction by the U. S. Reclamation Service; also concerning irrigable lands in public and private ownership which will eventually be reclaimed by means of proposed systems. It is printed in circular form for general distribution. A handbook relating to the operation of the Reclamation Act, prepared in the form of questions and answers, has also been issued by the Union Pacific for the information of the public generally.

Small Electric Motors.—Bulletin No. 4545, of the General Electric Company, Schenectady, N. Y., describes single-phase motors, type I. S., form K. G., ranging in size from ¼ h.p. to 15 h.p. The usual full dimensions and other information are given.

MANUFACTURING AND BUSINESS.

The plant which the Chicago Railway Equipment Co., Chicago, has been building at Grand Rapids, Mich., is nearly completed.

The name of the India Rubber & Gutta-Percha Insulating Co. has been changed to the Habirshaw Wire Co., 253 Broadway, New York.

L. W. Barber, Secretary of the Standard Car Truck Co., Chicago, was killed on the South Side Elevated Railroad in that city on January 5.

The Anderson-Lacy Electric Headlight Co., Houston, Tex., has shipped four locomotive headlight equipments to the Union Pacific for experimental use.

Charles F. Pierce has been appointed Manager of the railroad department of the New York & New Jersey Lubricant Co., New York, maker of non-fluid oils.

E. S. Nethercut, Chief Engineer of the Buda Foundry & Manufacturing Co., Chicago, has resigned. Mr. Nethercut will be in California for several months and expects to form no business connection until his return east.

E. M. Hedley, who has been in the experimental railroad department of the General Electric Co., Schenectady, N. Y., has been appointed General Superintendent of the Hudson & Manhattan, which is soon to start operation through its tunnels under the Hudson river.

C. W. Martin, Assistant General Manager of Jenkins Brothers, New York, died on December 31 of pneumonia. Mr. Martin was 37 years old. He had been with Jenkins Brothers for a number of years and in 1905 was Chairman of the Executive Committee of the Railway Supply Men's Association.

Robert W. Hunt & Co., inspecting and consulting engineers, Chicago, New York and Pittsburgh, have established a branch office and chemical laboratory at St. Louis, Mo., under the charge of Charles W. Gennett, Jr., M.E., formerly with the Baldwin Locomotive Works and the Southern Railway and lately Western Sales Agent of the Atha Steel Casting Company at Chicago.

A plan has been made public looking to the termination of the receivership of the Westinghouse Machine Co., Pittsburgh, Pa. It includes the issue of $7,200,000 three-year 6 per cent. notes secured by about $8,500,000 in bonds of the company. Claims of less than $1,000 are to be paid in cash and the others in notes. No dividends are to be paid until provision has been made for retiring the outstanding notes.

F. J. Cole, Mechanical Engineer of the American Locomotive Co., New York, has been appointed Consulting Engineer, with headquarters at Schenectady, N. Y. The office of Mechanical Engineer has been abolished and its duties will be included in those of William Dalton, Chief Engineer, whose headquarters are at Schenectady. Carl J. Mellin, Designing Engineer, has also been appointed a Consulting Engineer, with headquarters at Schenectady.

The E. H. Mumford Co., Philadelphia, Pa., has acquired all the patent rights, molding machines and equipment of Ph. Bonvillain and E. Ronceray in the United States and has added these machines and pattern processes to its molding machine line. The offices of the company will be moved from 17th and Callowhill streets, the present location, to 1315 Race street, where the French machines have been installed as a working exhibit for some months.

OBITUARY NOTICES.

John F. Fanning, a pioneer railroad builder of the Northwest, died in Chicago January 5, age 81 years. Mr. Fanning built parts of the Chicago, Rock Island & Pacific, the Northern Pacific and the Union Pacific lines.

Samuel Carpenter, formerly General Eastern Passenger Agent of the Pennsylvania, died at his home in New York on January 7. When he retired, a year ago, Mr. Carpenter had served on the Pennsylvania for 49 years.

Albert A. Folsom, Treasurer of the Eastern Railroad Association, died at his home in Brookline, Mass., December 24, at the age of 73. Mr. Folsom was for many years Superintendent of the Boston & Providence before it was merged in the Old Colony, having entered the service of that road in 1854.

Arthur G. Stanwood, Assistant Treasurer of the Chicago, Burlington & Quincy, died at his home in Boston, Mass., December 31, at the age of 58. Mr. Stanwood had spent the whole of his business life in the service of the Burlington road, having begun as a clerk in the Boston office. From that position he was rapidly promoted until he became Auditor. He had been Assistant Treasurer seven years.

Enos H. Tucker, who was a prominent figure in railroad life in Massachusetts for over 40 years, died at Needham, Mass., December 30, at the age of 93. Mr. Tucker began his railroad service on the Norfolk County Railroad in 1849 and had served on the Boston & Providence and on the New York & New England under its various names. He was for many years Superintendent of the Woonsocket division, retiring about 10 years ago.

Elmer E. Hill, Commissioner of the Colorado Car Service Bureau, died at his home in Denver last week Wednesday after a brief illness. He is survived by a widow and three children. Mr. Hill was born at Pleasant View, Ohio. He had been demurrage commissioner at Denver about ten years. Before that he was at Omaha. The Omaha demurrage bureau, established in 1887, was the first important institution of the kind in the country, so that Mr. Hill was the pioneer manager in this important reform.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, etc., see advertising page 24.)

American Society of Civil Engineers.

At the meeting of this society, January 8, the subject for discussion was the Use of Reinforced Concrete in Engineering Structures.

Canadian Society of Civil Engineers.

At the meeting of this society January 9, there was a discussion on Water Wheels in continuation of the discussion on the paper by W. Kennedy, Jr., which was read November 14.

International Master Boiler Makers' Association.

The Secretary wishes us to announce that the International Railway and Master Steam Boiler Makers' Association having consolidated, there is now only one association, the International Master Boiler Makers' Association, which will hold its next convention in Detroit, Mich., May 26-28, 1908. The officers are: George Wagstaff, President (N. Y. C.), Buffalo, N. Y.; E. S. Fitzsimmons, First Vice-President (Erie), Galion, Ohio; E. J. Hennessy, Second Vice-President (N. Y. C.), Depew, N. Y.; W. M. Wilson, Third Vice-President, Chicago, Ill.; E. W. Rogers, Fourth Vice-President (Am. Loco. Co.), Paterson, N. J., and Peter F. Flavin, Fifth Vice-President (Standard Ry. Co.), St. Louis, Mo. The Executive Committee is composed of: G. W. Bennett (N. Y. C.), West Albany, N. Y.; D. G. Foley, Green Island, N. Y.; P. J. Conrath, St. Louis, Mo.; A. N. Lucas, Milwaukee, Wis., and James J. Fletcher, Toronto, Ont. Harry D. Vought, Secretary, 62 Liberty street, New York, and Frank Gray, Treasurer, Bloomington, Ill.

Railway Signal Association.

The next meeting of this association will be held in lecture room No. 6, Engineering Societies building, 29 West 39th street, New York City, on Tuesday, January 14. At the morning session, 10 a.m., the subject to be discussed is the report of Committee No. 4, Automatic Block Signals, as presented at the annual meeting, at Milwaukee, and there accepted as a progress report without discussion. At the afternoon session, at 2 p.m., there will be a paper by F. R. Cook on Economical Operation of Electric Signals and Care and Maintenance of Storage Batteries; also the report of Committee No. 3, Electric Interlocking, beginning at No. 60, page 23, Advance Notice No. 5, 1907.

At the Executive Committee meeting on December 2, 1907, it was voted that dues for representative members for 1908 should be $1 per vote per annum. Instructions to committees are to be published in the annual proceedings. Proceedings for 1908 are to be published as follows: Subjects for March meeting to be mailed February 25; subjects for May meeting to be mailed May 1; subjects for September meeting to be mailed August 15. Advance notice of annual meeting to be mailed two weeks in advance of date of meeting; discussion at annual meeting to be mailed December 20. The September meeting is to be devoted to reading of papers presented and accepted by the Executive Committee; no reports of committees for annual meeting to be discussed.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Astoria & Columbia River.—F. B. Clarke has been chosen President in place of C. M. Levey.

Boston & Albany.—See New York Central & Hudson River.

Cincinnati, Hamilton & Dayton.—A. J. Anderson has been appointed Comptroller, with office at Cincinnati.

Cuba Eastern.—Edgar VanEtten, who has resigned his position on the New York Central, has been appointed President of the Cuba Eastern. The chief operating office of this road is at Guantanamo, Cuba.

Georgia & Florida.—F. Q. Brown has been elected First Vice-President; office at New York City. E. L. Bemiss has been elected Second Vice-President; office at Richmond, Va. W. H. Alexander is Auditor; office at Augusta, Ga.

Grand Trunk.—N. J. Power, Assistant Auditor, with office at Montreal, Que., has been appointed General Auditor, in place of H. W. Walker, who has been retired on pension after over 50 years in the company's service.

New York Central & Hudson River.—Edgar VanEtten, Vice-President in charge of operation of the Boston & Albany, has resigned. See Cuba Eastern.

New York Central Lines.—Alexander S. Lyman has been appointed General Attorney of the New York Central & Hudson River and of its leased and operated lines east of Buffalo, except the Boston & Albany. Clyde Brown has been appointed General Solicitor of this company and of its leased and operated lines east of Buffalo; and also of the Lake Shore & Michigan Southern, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Chicago, Indiana & Southern, the Indiana Harbor Belt and the Lake Erie & Western. He will have charge of legal matters relating to interstate commerce and traffic. Charles C. Paulding has been appointed Solicitor of the N. Y. C. & H. R. and of its leased and operated lines east of Buffalo, except the Boston & Albany. He will have charge of legislative matters. Messrs. Glennon, Cary, Walker & Howe have been appointed General Attorneys of the Lake Shore & Michigan Southern, and the C., C., C. & St. L., with office at LaSalle street station, Chicago. They will have charge of legal matters at Chicago and in its vicinity. Leonard J. Hackney has been appointed General Counsel of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Cincinnati. Henry Russell has been appointed General Counsel of the Michigan Central, with office at Detroit.

New York Public Service Commission, First District.—George S. Coleman has been appointed Counsel to the Commission in place of A. E. Blackmar. Office at New York City.

New York State Public Service Commission, Second District.—William A. Sutherland, of Rochester, has been appointed Counsel, with office at Albany, N. Y.

Pere Marquette.—J. L. Cramer has been appointed Vice-President and Comptroller, with office at Detroit, Mich. J. E. Howard has been appointed Secretary and Treasurer. While the P. M. and the Cincinnati, Hamilton & Dayton were operated jointly these men held similar positions at Cincinnati.

Portland & Seattle.—F. B. Clarke has been elected President, instead of Assistant to the President, as previously reported.

Seaboard.—S. L. Kamps was on December 27 appointed Assistant to the President, with office at Norfolk, Va.

Seaboard Air Line.—S. Davies Warfield and R. Lancaster Williams, appointed last week Receivers of this road, have designated President W. A. Garrett as Chief Executive Officer for the Receivers.

South Side Elevated (Chicago).—C. V. Weston, Chief Engineer, has been elected President and General Manager, succeeding M. Hopkins, deceased.

Toledo Terminal Railroad.—This company, successor of the Toledo Railway & Terminal Co., was organized at Toledo, December 31. The President is H. B. Ledyard, of the Michigan Central. General Manager Thomas B. Fogg is reappointed.

Operating Officers.

Ann Arbor.—See Detroit, Toledo & Ironton.

Atchison, Topeka & Santa Fe.—W. F. Buck, Mechanical Superintendent, at Topeka, has been promoted to the position of Superintendent of Motive Power, with office at Chicago, succeeding Alfred Lovell, resigned.

Atchison, Topeka & Santa Fe, Coast Lines.—J. Kinucan has been appointed Superintendent of Terminals at San Francisco, Cal.

Baltimore & Ohio.—Thomas Fitzgerald, General Manager, has resigned; but reports are uncertain as to whether he is to retire from the service of the company or is to be appointed to some other position.

Brookhaven & Pearl River.—W. H. Sullivan has been appointed General Manager, with office at Brookhaven, Miss., succeeding E. C. Enochs.

K. A. Smith has been appointed Assistant General Manager, with office at Bogalusa, La. F. I. Curtis is Superintendent; office at Brookhaven.

Canadian Northern Ontario.—C. W. Spencer, General Manager of this road and of the Canadian Northern Quebec and other Mac-

kenzie & Mann lines east of Fort William, has resigned. See Halifax & Southwestern.

Canadian Northern Quebec.—See Canadian Northern Ontario.

Canadian Pacific.—R. R. Jamieson, who was recently appointed General Superintendent of the Central division of the Canadian Pacific, with office at Winnipeg, Man., was promoted to that office from the General Superintendency of the Western division, which he had held since 1903. Mr. Jamieson was born in Wentworth county, Ont., and began his railroad service on the Great Western of Canada as telegraph operator in 1873. He subsequently went to the Grand Trunk and afterward for two years was engaged in the construction of telegraph lines in Indiana. After that he returned to Canada as agent and subsequently as despatcher on the Credit Valley road. That road was absorbed by the Canadian Pacific and from 1890 to 1896, Mr. Jamieson was Assistant Superintendent on the C. P. He was successively promoted to the positions of Superintendent of the Eastern division and of the Crow's Nest branch, and in 1903, as before stated, to the General Superintendency at Calgary.

R. R. Jamieson.

Chicago & Alton.—C. A. Goodnow, General Manager, has resigned and the position has been abolished. The authority of P. Houlahan, General Superintendent of the Toledo, St. Louis & Western, has been extended over the Alton, and his office will be at Chicago.

E. V. Dexter, General Inspector of Fuel, Equipment and Material, has resigned.

Detroit, Toledo & Ironton.—J. H. Fraser, heretofore Superintendent at Springfield, Ohio, has been appointed General Superintendent of this road and of the Ann Arbor Railroad and Steamship Lines, with office at Toledo, Ohio.

Grand Trunk.—James McCowan has been appointed General Car Accountant, with office at Montreal, Que., in place of W. H. Rosevear, retired on pension after 53 years in the service of the company.

W. H. Farrell has been appointed Superintendent of Terminals at Toronto, Ont.

Halifax & Southwestern.—W. B. Barclay has been appointed General Manager, with authority over the Mackenzie & Mann lines in the Maritime Provinces, including the Inverness Railway & Coal Company's line.

Houston Belt & Terminal.—J. R. Dillon has been appointed Superintendent.

Hudson & Manhattan.—Edward M. Hedley, heretofore with the General Electric Company, has been appointed General Superintendent of the Hudson & Manhattan. This company will soon open a line beneath the Hudson river between Hoboken and New York.

Mexican Central.—J. S. Reddoch has been appointed Superintendent at Aguascalientes, in place of J. H. Clegg. R. M. Elliott has been appointed Superintendent at Gomez Palacio. J. J. Lewis has been appointed Superintendent of Terminals at Tampico.

Northern Pacific.—G. A. Goodell has been appointed General Superintendent of the lines between Mandan, N. Dak., and Trout Creek, Mont., with office at Livingston, Mont.

Peoria & Eastern.—Thomas Hayes has been appointed Trainmaster at Bloomington, Ill., in place of W. F. Schaff.

Toledo, St. Louis & Western.—J. F. Clement, heretofore Superintendent of Telegraph, has been appointed Superintendent, with office at Frankfort, Ind. P. H. Houlahan, General Superintendent, who now has charge of the Chicago & Alton also, has moved to Chicago.

Tonopah & Tidewater.—W. W. Cahill, Assistant Superintendent, has been appointed Superintendent; office at Ludlow, Cal.

Washington, Idaho & Montana.—J. D. Morrissey has been appointed Superintendent, in place of J. D. Sullivan; office at Potlatch, Idaho.

Traffic Officers.

Brookhaven & Pearl River.—H. C. Homeyer has been appointed General Freight and Passenger Agent, with office at Brookhaven, Miss., in place of W. J. Helmick, resigned.

Chicago, Peoria & St. Louis.—C. W. Galligan has been appointed General Freight Agent. Office at St. Louis, Mo.

Chicago, Rock Island & Pacific.—A. D. Murray has been appointed General Agent at St. Louis, Mo.

Evansville & Terre Haute.—D. H. Hillman, General Freight and Passenger Agent, has resigned.

Gulf, Colorado & Santa Fe.—J. R. Dillon, Assistant General Freight Agent, has resigned. See Houston Belt & Terminal.

Mississippi Central.—R. D. Reeves has been appointed General Freight Agent, with office at Hattiesburg, Miss., in place of W. P. Emerson, resigned to become Secretary of the New Orleans Traffic Association.

Missouri, Kansas & Texas.—J. L. West, Assistant General Freight Agent, with office at St. Louis, Mo., has been promoted to the place of F. A. Leland, with the same title, Mr. Leland having resigned to become Chairman of the Southwestern Tariff Committee. W. W. Miller, Assistant General Freight Agent at Kansas City, succeeds Mr. West at St. Louis, and R. F. Campbell, heretofore commercial agent at Joplin, takes the place of Mr. Miller at Kansas City.

R. W. Hockaday has been appointed General Freight and Ticket Agent in Kansas, with office at Parsons.

Missouri Pacific.—B. Howard Payne has been appointed General Passenger and Ticket Agent, with office at St. Louis, Mo., in place of H. C. Townsend, resigned. W. H. Bissland has been appointed Assistant General Passenger and Ticket Agent, with office at St. Louis, succeeding Mr. Payne.

Southern.—L. A. Emerson, Assistant General Freight Agent at Charleston, S. C., has resigned and the office is abolished.

Engineering and Rolling Stock Officers.

Arkansas, Louisiana & Gulf.—E. G. Courtney has been appointed Master Mechanic of this new road, which has been built from Monroe, La., to Wardville, 30 miles.

Canadian Pacific.—Grant Hall has been appointed Superintendent of Motive Power of Western Lines, with office at Winnipeg, Man.

Chicago, Burlington & Quincy.—Joseph W. Cyr has been appointed Master Mechanic at Hannibal, Mo., in place of Isaac N. Wilber, resigned.

Chicago Great Western.—W. P. Chrysler, Master Mechanic at Oelwein, Iowa, has been appointed to the new office of Superintendent of Motive Power, with office at Oelwein, Iowa, succeeding to the duties of J. E. Chisholm, General Master Mechanic, resigned.

Grand Trunk.—James Coleman has been appointed Superintendent of the Car Department, with office at Montreal, Que., in place of William McWood, retired on pension after 52 years in the service of the company.

Illinois, Iowa & Minnesota.—H. S. Rogers, Engineer of Maintenance of Way, has resigned to go to another road, and the office has been abolished.

International & Great Northern.—O. H. Crittenden, Resident Engineer at Palestine, Tex., has been made Consulting Engineer.

Lake Shore & Michigan Southern.—O. M. Foster has been appointed Master Mechanic of the Michigan Southern division, with office at Elkhart, Ind., in place of M. J. McCarthy, resigned to go to the C., C., C. & St. L. as Superintendent of Shops at Beech Grove. John T. Carroll has been appointed Assistant Master Mechanic at Elkhart, succeeding Mr. Foster.

Mexican Central.—W. J. Dempster has been appointed Master Mechanic of the Monterey division, in place of J. A. Lewis, transferred. R. N. Millice has been appointed Master Mechanic of the Aguascalientes division in place of R. D. Gibbons, transferred. L. G. Wallace has been appointed Acting Master Mechanic at Guadalajara in place of R. N. Millice, promoted.

New York Central & Hudson River.—George H. Haselton, heretofore Division Superintendent of Motive Power at West Albany, has been appointed Assistant Superintendent of Motive Power, with office at New York City. Eben A. Walton, hitherto Division Superintendent of Motive Power at Oswego, succeeds Mr. Haselton at West Albany.

Rio Grande, Sierre Madre & Pacific.—J. M. Barnes has been appointed Master Mechanic; office at Ciudad Juarez, Mex.

Texas Midland.—N. L. Smitham, formerly Master Mechanic of the

Texas Central, has been appointed Master Mechanic of the Texas Midland, with office at Terrell, Tex., in place of O. W. Lewis, resigned.

Purchasing Agents.

Buffalo & Susquehanna.—B. D. Folwell has been appointed Purchasing Agent, with office at Buffalo, N. Y.

Chicago, Peoria & St. Louis.—E. A. Williams, General Passenger Agent, will henceforth have charge of purchases also, C. H. Besler, Purchasing Agent, having resigned.

Waterloo, Cedar Falls & Northern.—A. I. Breckenridge has been appointed Purchasing Agent, with headquarters at Waterloo, Iowa.

LOCOMOTIVE BUILDING.

The Delaware, Lackawanna & Western was recently in the market for 52 locomotives, but has postponed the order.

CAR BUILDING.

The Chicago Consolidated Traction is in the market for 500 or more cars.

The Little Rock & Pine Bluff has ordered 15 closed electric cars from the Jewett Car Co.

The Lehigh & New England is asking bids on 1,000 thirty-ton box cars and 250 forty-ton gondolas.

The Colorado & Southern is figuring on 12 interurban combination baggage and passenger cars for the Denver & Interurban.

The Chicago-New York Electric Air Line has ordered two electric cars from the Danville Car Co. for March delivery. These cars will measure 40 ft. 6 in. long and 8 ft. 5 in. wide.

The Waterloo, Cedar Falls & Northern, as reported in the *Railroad Gazette* of January 3, has ordered two interurban and ten 10-bench open cars from the McGuire-Cummings Co. for January and May delivery. The interurban cars will weigh 46,000 lbs. and will measure 52 ft. long and 8 ft. wide. inside measurements. The open cars will weigh 30,000 lbs. and will measure 31 ft. long, inside measurement. The special equipment for all cars includes:

Heating system, for interurban	Baker
Paint	Sherwin-Williams
Trucks, for interurban	McGuire-Cummings
Trucks, for open cars	Taylor
Wheels	Griffin

The New York, New Haven & Hartford, as reported in the *Railroad Gazette* of December 27, has ordered 10 blind end baggage cars, 10 unvestibuled baggage and smoking cars, five vestibuled smoking cars, three unvestibuled smoking cars, 27 unvestibuled passenger cars and one mail and letter car from Osgood Bradley & Sons for 1908 delivery. The blind end baggage cars will measure 60 ft. long, 8 ft. 11⅜ in. wide and 9 ft. high, inside measurements, and 63 ft. 3½ in. long, 10 ft. ¼ in. wide and 14 ft. high, over all. The unvestibuled baggage and smoking cars will weigh 78,000 lbs. and will measure 60 ft. 2 in. long, 8 ft. 11½ in. wide and 9 ft. high, inside measurements, and 68 ft. 8 in. long, 10 ft. ¼ in. wide and 14 ft. high, over all. The vestibuled smoking cars will weigh 83,500 lbs.; the unvestibuled passenger cars, 77,700 lbs.; and the unvestibuled smoking cars, 78,000 lbs. All these cars have the same measurements as the unvestibuled baggage and smoking cars. The mail and letter car will measure 61 ft. 10⅜ in. long, 9 ft. ⅜ in. wide and 9 ft. high, inside measurements, and 64 ft. 10 in. long, 10 ft. ¼ in. wide and 14 ft. high, over all. Bodies and underframes of all cars will be of wood. The special equipment for all cars includes:

Bolsters	Commonwealth
Brake-beams	Diamond special
Brake-shoes	Diamond S steel-back, flanged
Brakes	Westinghouse
Brasses	Magnus metal
Couplers	Buhoup 3-stem
Curtain fixtures	Forsyth
Curtain material	Pantasote
For unvestibuled baggage and smoking cars, vestibuled smoking cars, unvestibuled passenger and unvestibuled smoking cars.	
Draft rigging	Sessions-Standard, friction
Dust guards	Harrison
Heating system	Gold direct steam
Light	Commercial Acetylene
Platforms	Standard Coupler Co.
Roofs	Canvas
Trucks	Four-wheel
Vestibules	Buhoup blind end (for blind-end baggage cars and mail and letter cars); Buhoup wide (for vestibuled smoking cars).
Wheels	Paige plate, steel tires

The New York, Chicago & St. Louis, as reported in the *Railroad Gazette* of December 27, has ordered 1,000 box cars of 80,000 lbs. capacity from Haskell & Barker, for February delivery. These cars will weigh 35,500 lbs., and will measure 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, inside measurements. The special equipment includes Janney couplers and Haskell & Barker bolsters, brake-beams, brake-shoes, brasses, door fastenings, doors, draft rigging and dust guards.

RAILROAD STRUCTURES.

Beaver, Pa.—Plans have been made by the Pittsburgh & Lake Erie for building a steel bridge over the Beaver river.

Birmingham, Ala.—The Southern Railway, it is said, is double-tracking from Decatur Junction, for three miles, and will build two new steel bridges over the Tennessee river. The Louisville & Nashville has the joint use of this track. The cost of the improvement is about $500,000.

Denver, Colo.—Action will soon be taken by the city authorities towards building the 19th street viaduct.

Edmonton, Alb.—It is estimated that the cost of a proposed steel bridge for the Grand Trunk Pacific over the Pembina river west of this place will be about $250,000.

Elkhart, Ind.—The Lake Shore & Michigan Southern, it is said, has bought about 25 acres of land as a site for new shops here.

Fort William, Ont.—Contract is reported let to Barnett & McQueen at about $600,000 for rebuilding the Canadian Pacific elevator here.

Kaylor, Pa.—New car shops, it is said, are to be built by the Western Allegheny Railroad.

Minneapolis, Minn.—The Chicago, Milwaukee & St. Paul will put up a 16-stall steel addition to its engine house here.

New Westminster, B. C.—The plans for the steel bridge to be built over the north arm of Fraser river, provide for a combined highway and street railway bridge.

Owens, Wis.—The Fairchild & North-Eastern has given a contract to the Hennepen Bridge Company for putting up a steel bridge here.

Pittsburgh, Pa.—The Pittsburgh & Lake Erie is planning to put up a new freight station here.

Rochester, N. Y.—Announcement is made by Mayor Cutler that the New York Central has appropriated $1,500,000 for a new passenger station here. About seven acres and a half of land adjoining the present station in Central avenue have been bought, so that the entire site will comprise 14½ acres. The plans provide for a building to cost $1,100,000 east of Clinton avenue. The present station is west of Clinton avenue.

Topolobampo, Mex.—It is stated that the Mexican government will join the Kansas City, Mexico & Orient in converting Topolobampo into a first-class port. It is estimated that more than $15,000,000 gold will be spent in making the improvements planned, of which the K. C., M. & O., under the terms of the concession for which it has made application, agrees to furnish two-thirds. The railroad has bought Momocahul Island, at the entrance of the port, on which great terminal yards will be situated. Six steel piers will be constructed and the road will fill in the low places on the northern side of the harbor for about three miles.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Baltimore & Ohio.—This company recently began operating a new track known as the Alberton cut-off, on the old main line, from Davis, Md., east to Hollofields, four miles, completing the rebuilding of the old main line and making it a low grade line from Relay, Md., to Washington Junction. About three-quarters of a mile was saved and about 542 deg. of curvature eliminated. The maximum curve between these two places was reduced from 12 deg. to 7 deg., and westbound grade was reduced from .9 to .5 per cent., the eastbound to .3 per cent. The work, which took about two years to finish, cost about $750,000, and included a tunnel at Dorsey's, 1,025 ft. long, double-tracked and lined with brick, with stone portals; also a tunnel at Davis 498 ft. long, also double-tracked and lined with brick, with stone portals. Two deck girder bridges were also built on stone piers and abutments. The bridge at Davis has two spans, one of 90 ft. and one of 98 ft., and the bridge at Alberton three 90-ft. spans, one 100-ft. and one 26-ft. span. T. A. Shoemaker & Co., Philadelphia, were the contractors.

All trains will soon be operated over the new double-track line now building between Sterling, Ohio, and Nova, on the New Castle division, 15 miles. Over 2,000,000 yards of grading has been done in constructing this new line, and some 40,000 yards of Hone arch and bridge masonry erected. All the bridges and viaducts are arched and have ballasted tops. Double-track passing sidings are located just east of Lodi and at Homer. The new double-track between Nova and Sullivan and between the point of divergence east of Lodi and Sterling has been in operation for some time.

BROOKLYN RAPID TRANSIT.—During the year 1907 this company added 4,150 ft. of double track as follows: From Livingston and Court streets, in the Borough of Brooklyn, to Flatbush avenue, 3,400 ft., and on Lafayette avenue from Flatbush to Fulton street, 750 ft. On the Brighton Beach line the company has laid third and fourth tracks from Church avenue to Neptune avenue, 24,215 ft.

CAIRO & KANAWHA.—An extension of this road is projected from MacFarlan, W. Va., to Smithville, eight miles.

CANADA WEST COAL COMPANIES RAILROAD.—Announcement is made that this company, the head office of which is at St. Paul, Minn., will build a line to haul coke from Butte, Mont., north to the smelters at Calgary, Alb.

CENTRAL ONTARIO.—Contracts have been given by this company to build an extension from Maynooth, Ont., to Lake St. Peter, eight miles; also from Lake St. Peter to Whitney, 19½ miles.

GRAND TRUNK PACIFIC.—This company, which has given contracts for building its entire line from Winnipeg, Man., west to Edmonton, Alb., 789 miles, and which finished track laying on 325 miles of main line and 28 miles of sidings on this section in 1907, is pushing the work. Much delay was experienced last fall on account of bad weather and scarcity of ties. Near Drumague, Sask., 160 men are at work. Mild weather permits good progress to be made. It is hoped to have this section finished by spring.

GREAT NORTHERN.—Contract is reported let to F. P. Howard, of Maroon Valley, B. C., for work on the Vancouver, Victoria & Eastern, near Hedley, B. C.

GREENVILLE & KNOXVILLE.—This company is building an extension from Marietta, S. C., to River Falls, 11 miles, and has projected a further extension from River Falls to the North Carolina state line, 22 miles.

ILWACO RAILROAD.—See Oregon Railroad & Navigation.

KINGSPORT & BRISTOL.—Surveys are reported made and contracts are shortly to be let for building this proposed line from Kingsport, Tenn., east about 30 miles to Bristol. F. A. Cothran is Chief Engineer.

LITTLE ROCK, MAUMELLE & WESTERN.—This company, which built 16 miles of road last year in Arkansas, is making surveys for a 12-mile extension from Douglas.

LOUISVILLE & ATLANTIC.—Contracts have been given to Mason, Hanger & Coleman, of Richmond, Ky., and to the Canton Bridge Company, of Canton, Ohio, for building three miles of line for this company from Heidelberg, Ky., to Elk City. C. W. Moorman, Engineer Maintenance of Way, Richmond, Ky.

LOUISVILLE & NASHVILLE.—The work on the Cumberland division reducing grades between Barbourville and Flat Lick, 3.10 miles, in Knoxville county, Ky., is about finished.

On the Kentucky division grading has been finished and second-track laid from Livingston to Berth, 2.60 miles; from East Bernstadt to Pittsburgh, 2.70 miles; from Little Laurel River to Frantz, 3.40 miles, and also from Lynn Camp Creek to mile post 172, one mile, all in Kentucky.

During 1908 grading work and second track is to be laid on the Kentucky division from Perth to East Bernstadt, nine miles, and a new double-track line is to be built between Pittsburgh and Little Laurel River, 6.80 miles. A new double-track line is also to be built between Frantz and Lynn Camp Creek, 6.50 miles.

On the South & North Alabama between Graces, Ala., and Hardy, 17 miles, work is under way reducing grades and revising the line. A second track is also to be added, which will probably be finished early this year.

On the Pine Mountain Railroad between Clear Fork River, Ky., and Gatliff coal mines, 17 miles, it is expected to have grading work and track laid this year; also a branch diverging from this line at Yost to Mahan, 2.30 miles.

The Swan Creek Railway has laid track from Mount Pleasant, Tenn., for about four miles, leaving 13½ miles yet to be built to complete the line to Flanagan. It is expected to have the work finished early this year.

NEVADA-CALIFORNIA-OREGON.—This company is building with its own men an extension from Likely, Cal., to Alturos, 20 miles. A further extension is projected from Alturos to Lakeville, 60 miles.

NEW YORK, AUBURN & LANSING (ELECTRIC).—This company, which is building an electric line from Auburn, N. Y., to Ithaca, 39 miles, has track laid from Auburn to Genoa, 19 miles, and during 1907 finished the section from Myers to South Lansing, 10.9 miles, and from Ithaca to McKinneys, 1.1 mile. Work is under way by the Auburn Construction Company from South Lansing to McKinneys, 4.1 miles. (July 26, p. 111.)

NEW YORK SUBWAYS.—The New York State Public Service Commission, First district, has approved the building of a subway from the south end of Manhattan Island northward, most of the way through Broadway as far as Eleventh street, then under private property to Lexington avenue and thence northward to the Harlem river; beyond which the line branches; the western arm going to Woodlawn by way of Jerome avenue, and the eastern to Pelham Bay Park. The Commission has ordered plans and estimates prepared, but has taken no further definite action.

OREGON RAILROAD & NAVIGATION.—Work is under way by this company finishing extension as follows: Between Elgin, Ore., and Joseph, on the remaining 56½ miles, and between St. John and Woodlawn on 1.80 miles;

On the Oregon, Washington & Idaho, between Riparia, Wash., and Lewiston, Idaho, 37 miles.

On the Ilwaco Railroad, between Ilwaco, Wash., and Knappton, 9.40 miles.

OREGON, WASHINGTON & IDAHO.—See Oregon Railroad & Navigation.

OSCEOLA, LITTLE RIVER & WESTERN.—An extension has been projected by this company from Youngs, Ark., to Little River, seven miles.

PINE MOUNTAIN RAILROAD.—See Louisville & Nashville.

PITTSBURGH, SHAWMUT & NORTHERN.—This company has finished relocating its line from Paine, Pa., to Detsch, five miles. On this section the ruling grades have been reduced and 1,000 deg. of curvature have been eliminated.

SALT LAKE & OGDEN.—This company is building an extension from Ogden (Utah) city limits to Canyon, 5.60 miles.

SOUTH & NORTH ALABAMA.—See Louisville & Nashville.

SOUTH & WESTERN.—This company, which last year added 22 miles to the line it is building from Elkhorn, Ky., south to Bostick, N. C., expects to finish all the work from Dante, in Russell county, Va., south to Bostick, during 1908. On this section grading is 70 per cent. finished, also the tunnel and masonry work.

SWAN CREEK RAILWAY.—See Louisville & Nashville.

VANCOUVER, VICTORIA & EASTERN.—See Great Northern.

VERSAILLES & SEDALIA.—This company has projected an extension from Ouachita, Mo., to Sedalia, 24 miles.

VIRGINIA AIR LINE.—This company, which last year built 17 miles of railroad between Lindsay, Va., and Palmyra, has work under way on 13 miles. J. N. H. Cornell & Co., Gordonville, Va., are the contractors. W. Washabaugh, Chief Engineer, Charlottesville, Va.

WASHINGTON, WESTMINSTER & GETTYSBURG.—This company, which built 25 miles of its line between Washington, D. C., and Laytonsville, Md., last year, is making surveys to build three miles additional in the District of Columbia, with a terminus at 15th and H streets, N. E. The line will probably be operated by gasolene motor cars. J. B. Colegrove, President, Washington, D. C.

WISCONSIN & NORTHERN.—An extension is being built from Crandon, Wis., south three miles. Surveys made to extend the line from Van Ostrand, Wis., north to a point south of Crandon, 28 miles.

WOODVILLE RAILROAD.—This company, which last year built four miles in Florida, has projected an extension from Lavender to Crawfordville, 10 miles.

RAILROAD CORPORATION NEWS.

ATCHISON, TOPEKA & SANTA FE.—Gross earnings of the system increased slightly in November. Operating expenses were $1,250,000 larger, leaving a decrease of $1,180,000, or 37 per cent. in net earnings; this with an increase of 154 miles in mileage operated. This decrease in net earnings followed a decrease of $1,240,000 in the month of October. For the five months ended November 30, gross earnings increased $2,800,000 and net earnings decreased $3,260,000.

BALTIMORE & OHIO.—See Chicago Terminal Transfer.

BOSTON & MAINE.—This company has $1,000,000 5 per cent. one-year notes outstanding which mature on January 15. Through R. L. Day & Co. these have been renewed at 6 per cent. until January 6, 1909. Another $1,000,000 notes mature on February 15 and a third block of the same size on March 15.

CANADIAN PACIFIC.—An issue of $24,826,000 additional common (ordinary) stock is to be offered at par to stockholders of record January 14 on the basis of one share of new stock for each five shares held. Payments of 20 per cent. each are to be made on or before February 19, April 21, June 19, August 19 and October 19. This issue was approved by the shareholders in special meeting on December 30.

CHICAGO & ILLINOIS WESTERN.—This road, which has 17 miles of line in operation in the outskirts of Chicago and 37 miles

under construction, has made a mortgage covering $4,000,000 40-year, 6 per cent. bonds. The proceeds are to be used for new construction.

Chicago Great Western.—A. B. Stickney, President of this company, and Charles H. F. Smith, of St. Paul, were on January 8 appointed receivers. This action was taken as a direct result of Mr. Stickney's failure to make arrangements in London to fund about $1,500,000 five-year sterling 5 per cent. notes which fall due this month. There are also about $2,000,000 more of these notes maturing this year and $4,000,000 notes maturing in 1909. Frank B. Kellogg, of St. Paul, who asked for the appointment of the receivers, said that notes to the amount of $545,000 had already gone to protest. There are no mortgage bonds issued on the 818 miles of the Chicago Great Western proper. It is the intention to create a $20,000,000 first mortgage bond issue on these main lines with which to fund the notes and other obligations outstanding and to double-track and improve the road, whose facilities have been insufficient for its traffic. Including the Mason City & Fort Dodge and the Wisconsin, Minnesota & Pacific, component parts of the system, the Chicago Great Western operates 1,476 miles of road.

Chicago Terminal Transfer.—The stockholders' protective committee has announced that the Baltimore & Ohio has not yet ratified the arrangement by which the committee was to sell not less than $4,500,000 of the $17,000,000 preferred stock of the Chicago Terminal Transfer at $25 a share. The committee, which represents upwards of $6,500,000 of the preferred stock, believes that the Burlington owns or controls about $7,500,000 of it. The offer of the Baltimore & Ohio has not been rescinded.

Cincinnati & Muskingum Valley.—See Pennsylvania Company.

Cincinnati, Hamilton & Dayton.—A special meeting of the stockholders is to be held on February 7 to authorize an issue of $14,286,000 five-year 4 per cent. purchase money notes, whose proceeds are to be used for retiring the refunding mortgage 50-year 4 per cent. bonds of 1954, of which $11,557,000 are outstanding. The maturity of these bonds is to be changed from 1954 to 1913. Interest on them is not in default. This is a step toward the termination of the receivership.

Cleveland & Marietta.—See Pennsylvania Company.

Colorado & Southern.—With an increase of 178 miles, gross earnings for the month of November, 1907, were $1,422,244, an increase of $272,526; net earnings $546,139, an increase of $169,685. Gross earnings for the five months ended November 30 were $6,452,976, an increase of $898,204; net earnings $2,311,218, an increase of $386,538.

Gulf & Chicago.—See New Orleans, Mobile & Chicago.

Louisville & Nashville.—Net earnings for the month of November decreased 45 per cent. from the net earnings for November, 1906. Gross earnings for November, 1907, were $3,900,000, a decrease of $174,000; operating expenses increased $450,000, leaving net earnings of $753,000, a decrease of $624,000. The operating ratio was 80.75 per cent., against 66.3 per cent. in 1906. For the five months from July 1 to November 30, 1907, the loss in net earnings was $735,500, only a little more than the decrease for the month of November alone.

Mobile, Jackson & Kansas City.—See New Orleans, Mobile & Chicago.

New Orleans, Mobile & Chicago.—This is the name of a company which is to take over the Mobile, Jackson & Kansas City and the Gulf & Chicago, probably some time during the present month. Most of the bondholders of the two companies which are to be taken over have agreed to this action under a plan of reorganization by which securities of the old roads will be exchanged for those of the new company. The interest payments due January 1 on the bonds of the Mobile, Jackson & Kansas City and the Gulf & Chicago were not paid, but are to be funded with securities of the new company.

New York Central Lines.—Gross earnings for the month of November were as follows:

	1907.	Change	
New York Central & Hudson River	$7,876,736	Dec.	$205,603
Lake Shore & Michigan Southern	3,717,084	Inc.	281,528
Lake Erie & Western	391,671	Dec.	23,731
Chicago, Indiana & Southern	243,493	Inc.	40,826
New York, Chicago & St. Louis	809,894	"	3,787
Michigan Central	2,351,998	Dec.	135
Cleveland, Cincinnati, Chicago & St. Louis	2,208,060	Inc.	151,167
Peoria & Eastern	235,718	Dec.	18,063
Cincinnati Northern	79,687	"	2,507
Pittsburgh & Lake Erie	1,277,367	Inc.	15,469
Rutland	260,277	"	26,857

New York City Railway.—Frederick W. Whitridge was on January 6 appointed Receiver of the Third Avenue Railroad. In March, 1900, the Metropolitan Street Railway acquired control of the Third Avenue, then in the hands of a receiver, and shortly afterward leased it for 999 years, at the same time agreeing to pay, beginning in 1904, annual dividends of from 5 to 7 per cent. on its stock. In the course of the present receiverships of the New York City Railway and its leased company, the Metropolitan Street Railway, this guaranteed dividend has been defaulted. In December the receivers of the two controlling companies made a report on the condition of the Third Avenue Railroad, which showed that no charge had been made for depreciation of the property, and that in consequence it was in bad condition.

New York, New Haven & Hartford.—The steamer lines running on Long Island Sound in which the New York, New Haven & Hartford is interested are now operated by two companies: The New England Steamship Company operates the lines which are directly owned and the United States Transportation Company operates the lines of which the New Haven's control is not so definite. The New England Steamship Company on January 4 opened an all-water freight line between New York and Boston. There are to be three sailings a week from each city, and the trip is to be made in 20 hours. The steamers "Bunker Hill," "Old Colony" and "Massachusetts" are to be used on this route.

Ohio Connecting.—See Pennsylvania Company.

Pennsylvania Company.—In the table published in the *Railroad Gazette* of January 3, 1908, page 11, showing new railroad capital authorized or issued during the calendar year 1907, through a mistake, the Pennsylvania Company was shown to have issued $50,000,000 three-year 5 per cent. collateral improvement notes, which refunded a like amount of 4½ per cent. notes due November 1. The Pennsylvania Company, however, did not issue any obligations during the year 1907, and the $50,000,000 collateral-improvement notes which matured November 1 of that year were paid off and canceled. The $50,000,000 notes maturing November 1, shown to have been refunded by the issue of $60,000,000 notes by the Pennsylvania Railroad, were the Pennsylvania Company's notes already referred to, which matured November 1.

Increased annual dividends on stocks of subsidiary companies were declared at the end of 1907 as follows: Cincinnati & Muskingum Valley, 4 per cent., the rate having been 2 per cent. since 1900; Ohio Connecting Railway, 7 per cent., rate in 1906 being 5 per cent.; Cleveland & Marietta, 4 per cent., rate in 1906 3 per cent.; Toledo, Walhonding Valley & Ohio, 2 per cent., none paid in 1906.

Seaboard Air Line.—On application of the attorneys of this company in a bill stating that there was due on January 1. 1908, on bonds and equipment notes $765,000, and for taxes, traffic balances, pay-rolls, supplies and other claims, many of them overdue, more than $2,000,000, besides a floating indebtedness of about $3,000,000, all of which the company was without funds to meet, the United States Circuit Court for the Eastern district of Virginia on January 2 appointed S. Davies Warfield and R. Lancaster Williams, receivers of the Seaboard Air Line Railway. Mr. Warfield is President of the Continental Trust Company of Baltimore, which is trustee under the first mortgage, and probably represents the Ryan-Blair interests, which have controlled the company. Mr. Williams is a brother of John Skelton Williams, formerly president, and for the past three years a bitter critic of the company's policies. The receivers have been given authority to borrow money to pay the bond interest and the amount due on equipment notes. The object of the receivership was to maintain the system intact pending reorganization. The company had no funds nor credit on which to borrow, and therefore a receivership was necessary in order to protect it from disintegration.

Southern.—Gross earnings for November decreased slightly and net earnings showed a decrease of 9 per cent. The December results are understood to have been still more unfavorable, but the current month shows better results both in gross and net earnings.

Tallulah Falls.—W. S. Irwin, General Manager, and L. R. Adams were on January 7 appointed temporary receivers of the Tallulah Falls Railway, on application of H. H. Dean, of Gainesville, Ga., in a bill alleging that there are current floating debts amounting to over $40,000. The road runs from Cornelia, Ga., on the Southern Railway, north to Franklin, N. C., 57 miles.

Third Avenue Railroad.—See New York City Railway.

Toledo & Indiana (Electric).—This company has postponed payment of the semi-annual interest due January 1 on its $1,650,000 first mortgage 5 per cent. bonds. Many of the bonds are held by the directors of the company and it is therefore believed that a receivership will be avoided.

Toledo, Walhonding Valley & Ohio.—See Pennsylvania Company.